emerge
one-to-one laptop learning

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Emerge One-to-One Laptop Learning Initiative: Final Report

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Emerge One-to-One Laptop Learning Initiative: Final Report

This document is available on the Internet at: http://www.education.alberta.ca/admin/technology/emerge-one-to-one.aspx.

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Executive Summary

> *The Emerge Project has helped all our teachers, not just the Emerge teachers, realize how technology and students are changing, and how we need to change our pedagogy to match the 21st Century learning environment.*
> *-Emerge Project Lead*

The Emerge One-to-One Laptop Learning Project (Emerge) was established in 2006 by Alberta Education to investigate the efficacy of laptops for teaching and learning in the 21st Century. Alberta Education used a competitive process in 2007 to award three-year grants to 20 jurisdictions, involving 50 schools. Each of the 20 jurisdictional grantees selected a specific target population, or 21st Century Skill set, as a focus for their three-year grant award. Many of the Emerge jurisdictions focused on a common set of 21st Century Skills such as critical thinking, collaboration, global awareness, or information and communication technology (ICT).

The Emerge jurisdictions deployed one-to-one laptop learning at specific grade levels or with specific student populations within their targeted schools. None of the Emerge programs were school-wide deployments. While in some Emerge programs the laptops followed the students (for as long as those students were enrolled in the host school), other jurisdictions made the decision to keep the laptops at specific grade levels, which meant new groups of students in the program each year. Still others had hybrids of the two approaches.

Emerge Implementation Models

In some Emerge programs, the laptops followed the students, while in other jurisdictions the laptops stayed at specific grade levels, with new groups of students participating each year of the program. Many jurisdictions used hybrid approaches that included both models. The jurisdictions also instituted varied policies and practices as to whether students took the computers home.

In addition to awarding the jurisdictional grants, Alberta Education established an Emerge Community of Practice (COP) that was facilitated by an annual Summer Institute; bi-annual face-to-face professional development days; periodic professional development webinars; and a virtual site for Emerge communication and online exchanges of information and resources. The three-year project culminated in a final summer institute.

Methodology

This report summarizes the results of the evaluation study of the Year 3 implementation of Emerge. A longitudinal, mixed-methods evaluation design, encompassing both qualitative and quantitative data, was employed. The design involved an initial alignment of indicators and measures based on the following five research questions developed by Alberta Education:

1. What are the potential educational benefits of one-to-one laptop learning?
2. What are the technical merits and innovative practices in one-to-one wireless learning?
3. What expertise, experience and lessons learned have come from the Emerge One-to-One Laptop Learning Project in Alberta?
4. What is the level of jurisdictional and provincial readiness for systemically advancing 21st Century Learning and effective uses of technology in learning?
5. What are the trends and/or variances across indicators over time?

The researchers selected to evaluate the Emerge project included a team from the Metiri Group and the University of Calgary. The evaluation collected data from surveys of teachers, administrators and a project lead from each jurisdiction; data from annual site observations in each of the 20 jurisdictions; and observations at Emerge events. Data were then analyzed, triangulated and reported in the fall of 2007 as baseline, and repeated again in the spring of 2009 and 2010 for trends.

Because new students and teachers joined the project each year, additional data collections were conducted in Fall 2008 and Fall 2009. The evaluation of student outcomes included a review across the years of engagement and self-direction for all Emerge students, plus pre and posttests for two groups of students: 1) those involved in a mature Emerge program for a full year; and 2) those involved in a mature Emerge program for a full two years. A mature year is defined to be a complete school year in which the Emerge program was fully operational. Therefore, the first year of Emerge is not considered a mature year. This Year 3 report addresses the first four research questions. The fifth question is answered through the trends and findings in the first four questions.

Results: Student Outcomes

A common theme across the jurisdictions in the second year of the Emerge initiative was a shift in focus from the technological to the pedagogical. In this third year of the program that theme continued with an even more marked emphasis on leveraging the use of the technology to advance student learning within the academic content areas. Within some of the Emerge classrooms a transformation occurred as teachers, students and administrators learned through experience how to tap into the power of the technology to advance academic and 21st Century Learning goals.

Year 3 Emerge Trends: Student Outcomes

The Emerge students became more expert in the use of technology to augment their learning through increased engagement in complex thinking and inquiry learning, informed access to Internet-based context and resources, diverse online communications, and student development of technology-based projects that demonstrated their learning.

The Emerge students became more expert in the use of technology to augment their learning through deep engagement in complex thinking and inquiry learning, informed access to Internet-based context and resources, diverse online communications, and student development of technology-based projects that demonstrated their learning. Emerge teachers reported significant gains in attainment of 21st Century Skills over what was reported at baseline. However, jurisdictions varied considerably as to the grade levels, content areas, and 21st Century Skill sets focused on within their projects.

Student outcomes also included tracking levels of student engagement and self-directed learning. In this, the evaluation team used two types of evidence to draw inferences about the impact of Emerge on students: (1) *repeating cross-sectional data*—measures of association between participation in Emerge and behaviors at the time data were collected; and (2) *longitudinal data*—measures of association, for the same group of students who were observed at multiple points in time.

Year 3 Emerge Trends: Student Engagement

Student engagement in the Emerge program was fairly high across the three years of the program.

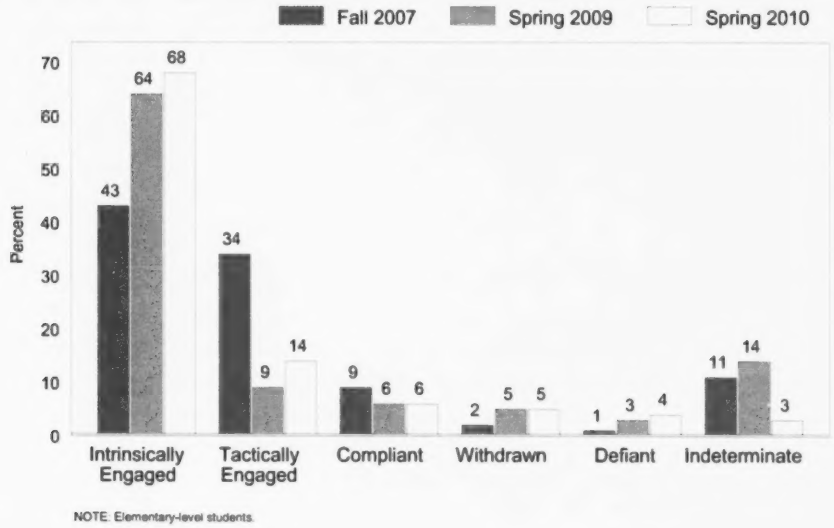
Trends in Emerge levels of student engagement were consistently higher than Canadian engagement trends would have predicted.

Repeating cross-sectional data provide a snapshot of student performance in a particular year and then take another snapshot of a similar group of students in a later year; for example, comparing third grade students in 2008-09 to third grade students in 2009-2010.

Longitudinal data refer to data collected from the same group of students over time; for example, from third grade students through fifth grade. Examining this subset of students, herein referred to as the *longitudinal sample*, makes it possible to obtain information concerning individual patterns of change. However, in comparison to using all students (cross-sectional sample), the use of the longitudinal sample for analysis has the following two disadvantages: it reduces the sample size; and limits the generalizability of the conclusions.

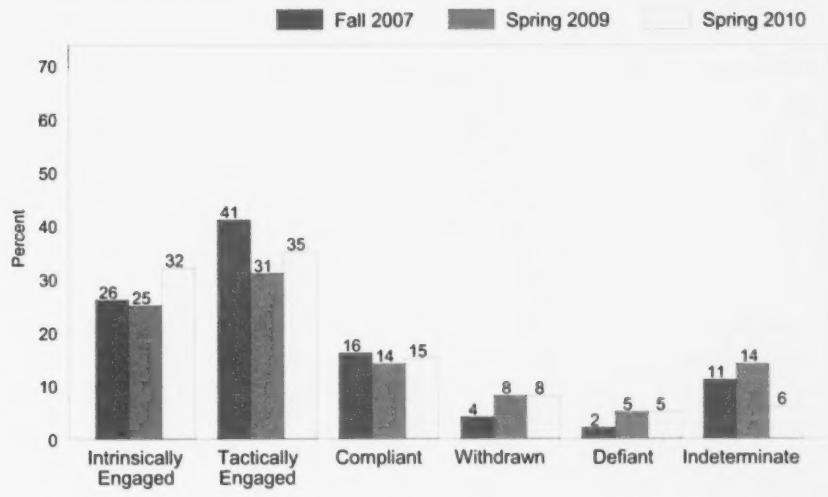
As shown in Figure 1, the *cross-sectional* sample of elementary-level (Grades 3-5) students displayed major increases in their intrinsically engaged scores, shifting from 43% intrinsically engaged in Fall 2007 to 68% intrinsically engaged in Spring 2010. Similarly, as shown in Figure 2, the secondary (Grades 6-12) students in the cross sectional analysis displayed a slight increase in their intrinsically engaged scores, shifting from 26% intrinsically engaged in Fall 2007 to 32% intrinsically engaged in Spring 2010. On the whole, elementary students' engagement scores were consistently higher than secondary students' engagement scores in the cross sectional analysis. Interestingly, both groups of students in the cross sectional analyses presented decreases in their tactical engagement classifications.

Figure 1: Cross sectional student engagement for elementary students (Grades 3-5)



NOTE: Fall 2007 N=1,604; Spring 2009 N=1,619; Spring 2010 N=1550.

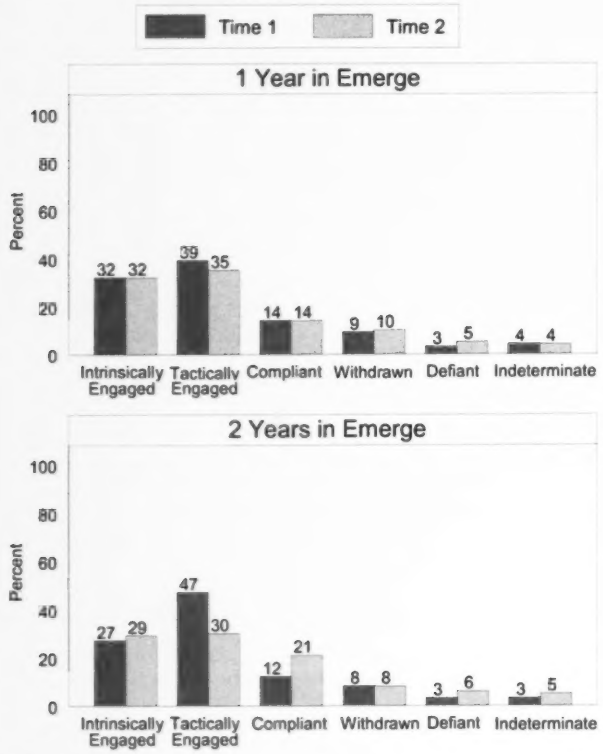
Figure 2: Cross sectional student engagement for secondary students (Grades 6-12)



NOTE: Secondary-level students.

The results of the longitudinal analyses, looking at student data with matched pre and post tests, paint a somewhat different picture than the cross-sectional analyses for the secondary students. The secondary students in the longitudinal analyses remained the same or demonstrated declines in their engagement levels. With the *1 Year* group remaining at 32% intrinsically engaged at both time points (Time 1 and Time 2) and the secondary students in the *2 Years* group shifting from 27% intrinsically engaged to 29% intrinsically engaged at Time 2, Figure 3. Further, both groups of secondary students in the *1 Year* and *2 Years* groups displayed 3 to 4% decreases in their identifications as tactically engaged from Time 1 to Time 2. Meanwhile, the elementary students in the longitudinal analyses had positive results. These elementary students, Figure 4, exhibited an increase in their intrinsically engaged classifications, moving from 71% and 56% intrinsically engaged at Time 1 (*1 Year* and *2 Year* groups respectively) to 73% and 68% intrinsically engaged at Time 2 respectively. The terms *1 Year*, *2 Year*, Time 1, and Time 2 will be explained in detail during the discussion on the methods of analysis for the student data.

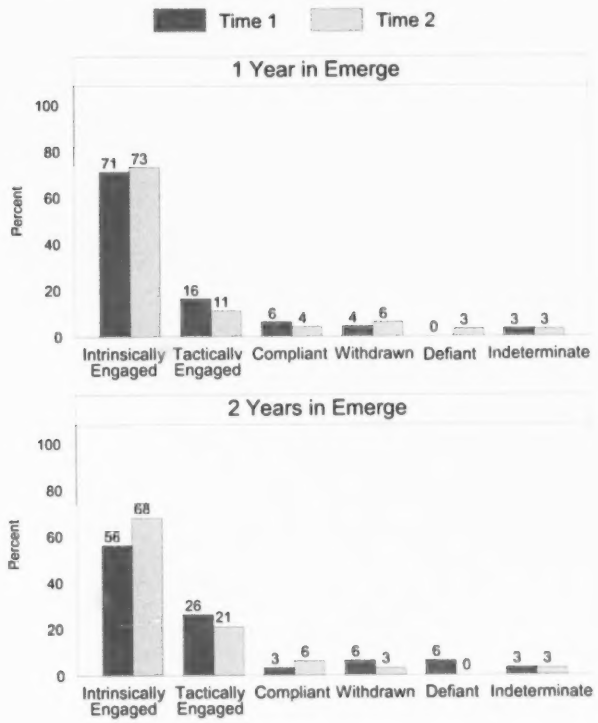
Figure 3. Percentage of students in each engagement, secondary students



NOTE: Secondary-level students.

NOTE: 1 Year [in Emerge] Secondary *N*=680; 2 Years *N*=210.

Figure 4: Percentage of students in each engagement, elementary students



NOTE: Elementary-level students

From a cross-sectional analysis, Emerge students consistently maintained fairly high levels of self-direction from the Fall 2007 baseline through Spring 2010. However, a closer look at the longitudinal trend lines of matched pre and posttests of groups of students that participated in either one or two mature years of Emerge found some slight declines. This may be due in part to the difficulty of increasing levels of self-direction. Research suggests that increases result only when teachers provide purposeful strategies for building self-direction throughout the students' entire school day. In addition, not all jurisdictions specifically targeted self-direction as a key skill for development within Emerge.

Results: Readiness of Jurisdictions for 21st Century Learning

In addition to student outcomes, the status of Emerge jurisdictions in establishing 21st Century Learning environments was documented by tracking the level of systemic change in classrooms, schools, and jurisdictions by surveying teachers and administrators. Based on Metiri Group's Dimensions21™ framework, seven interdependent dimensions of the current status and readiness of schools for 21st Century Learning were calculated: 1) Forward Looking, Shared Vision, 2) Systems Thinking, 3) 21st Century Skills and Instructional Approaches, 4) 21st Century Learning Environments, 5) Educator Proficiency in 21st Century Learning, 6) Access and Infrastructure, and 7) Accountability/Results.

Based on staff responses to close-ended questions on the D21™ surveys, teacher and administrator scores were calculated separately, weighted and then combined into one aggregate score for all seven dimensions. Scores range from 1-8 with 1-2 indicating the *Awareness* stage, 3-4 indicating the *Exploration* stage, 5-6 indicating the *Scaling Up* stage, and 7-8 indicating the *Systemic* stage. Figure 5 shows the aggregate scores (i.e., the weighted average of teacher and administrator survey data) for the seven D21™ dimensions across years (Fall 2007, Spring 2009, Spring 2010).

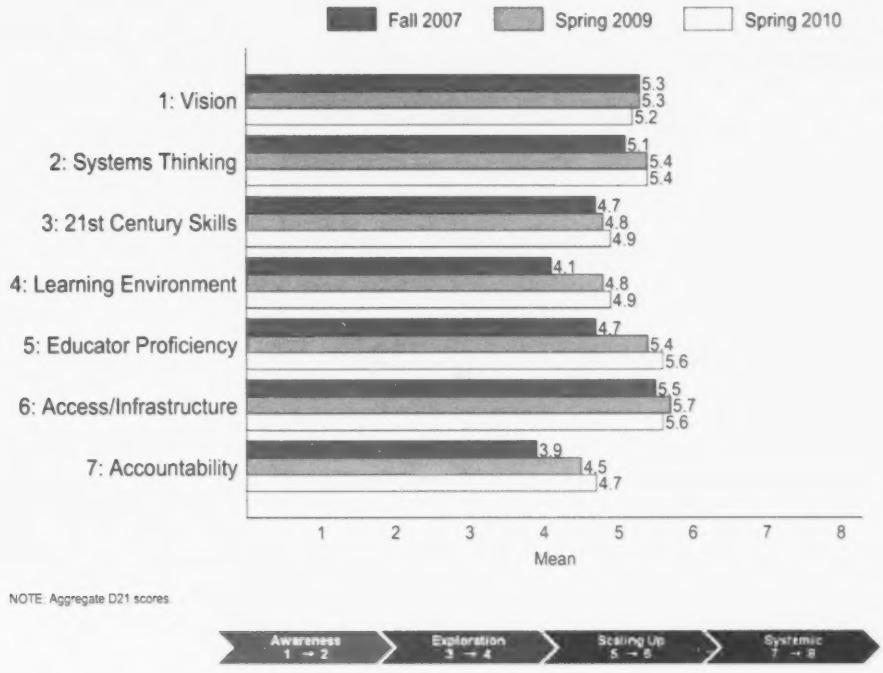
Year 2 Emerge Trends: System Readiness for 21st Century Learning

The Emerge jurisdictions, collectively, made steady progress on the 7 Dimensions of Readiness for 21st Century Learning.

While the highest scores were registered in Access and Infrastructure, and Educator Proficiency, the greatest gains were made in Educator Proficiency and Accountability. The dimensions with the greatest opportunity for growth continue to be in the Learning Environment and in Accountability.

Results indicate that the 20 Emerge jurisdictions are at various stages of transformation toward establishing 21st Century Learning environments. Metiri Group's experience with readiness indicators suggests that schools in the initial stages of launching one-to-one laptop programs typically report two leading (i.e., higher scoring) indicators: *Vision* and *Access/Infrastructure*. The other indicators that lag typically increase in iterative stages once the school begins implementation. With few exceptions, the Emerge schools followed this pattern. At the start of the Emerge program, the leading indicators were *Vision* and *Access/Infrastructure*. Now, at the end of the third year, the Emerge schools are closing the gap between lagging and leading indicators, with the 20 jurisdictions, in the aggregate, reporting significant gains in the two indicators, *Educator Proficiency with 21st Century Learning Environments* and *Accountability/Results*. All indicators had moved into the *Scaling Up* range by the third year of the Emerge program. The dimension scores suggest that, while much progress has been made, the changes are not yet *Systemic* in all jurisdictions.

Figure 5: Trends across Years 1-3 showing mean dimension scores: Dimensions of Readiness for 21st Century Learning



Fall 2007: *N* =108 Teachers and 46 Administrators

Spring 2009: *N* =129 Teachers and 46 Administrators

Spring 2010: *N* =116 Teachers and 53 Administrators

Sustainability

Overall, the trend data demonstrate that the 20 Emerge jurisdictions are generally well staged to continue *Scaling Up* technology-based learning, and to move eventually into the *Systemic* stage of institutionalizing 21st Century Learning for all students.

Year 3 Emerge Trends: Sustainability

The Emerge jurisdictions have used this project to explore and investigate the instructional, curricular and assessment changes necessary to establish effective 21st Century Learning environments.

Most have established sound technology systems to support such learning. They have established policies and practices that leverage new approaches to learning made possible through these digital tools and the Internet access.

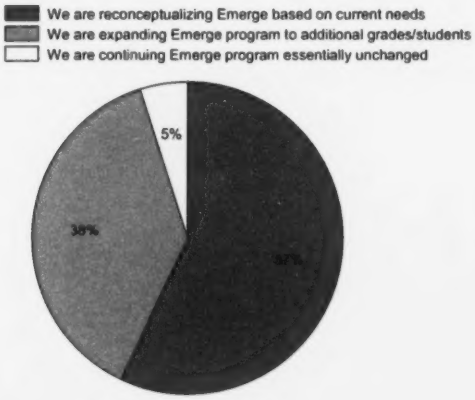
They have also made strides toward establishing 21st Century Learning environments, in part by optimizing such systems through appropriate assessments such as rubrics for 21st Century Learning. They have also formed a strong, interactive community of practice with Emerge colleagues that will serve them well as they continue to evolve policies and practices in 21st Century Learning.

In the last year of the Emerge programs, the Emerge leads have purposefully turned their attention to sustainability. As Figure 6 indicates, the Emerge Project Leads suggest that there is "no going back," and that the Emerge program has served as a launching point for system wide change. Yet the jurisdictions are grappling with how to use what they learned over the last year to bring 21st Century Learning to scale in their jurisdictions.

Year 3 Emerge Trends: Sustainability

Most jurisdictions reported that they will continue the concept of mobile computing. However, given the advances in technologies, they are reconceptualizing the Emerge model into their next stage of development toward 21st Century Learning.

Figure 6: Sustainability plans beyond Emerge, as reported by the Emerge Project Leads


We are reconceptualizing Emerge based on current needs
We are expanding Emerge program to additional grades/students
We are continuing Emerge program essentially unchanged
5%
38%

SOURCE: Survey of Emerge Project Leads, *n*=18 (2 non-respondents).

One of the challenges in every grant program is the sustainability of the curricular interventions launched during the grant award period. Emerge is no exception. Alberta Education conceptualized Emerge as a research program intended to investigate the efficacy of one-to-one laptop learning. Alberta Education representatives made it clear from the inception of the program that there was an expectation that, after the third and final year of the program, the jurisdictions would be expected to have identified best practices and have developed and begun implementation of a plan for sustainability of such practices launched during Emerge.

> *The impact of 24/7 access to technology on instruction is profound. The ability to respond to students' spontaneous inquiries and research them together immediately is wonderful. Student engagement increases, and the students' abilities to self-direct their learning is also significant. It also becomes easier to differentiate learning for students. However, it takes time for teachers, students and parents to understand the full potential of technology and to realize that technology is just one of many instructional tools that teachers have available to them. We are just beginning to understand the potential of other types of technology such as cell phones and iPods.*
>
> *-Emerge Project Lead*

A number of trends have emerged during Year 3. Observations indicate that the Emerge program has resulted in these lessons learned:

- 21st Century Learning is the new standard for education.
- The Emerge program was able to arrest a significant percentage of the projected decline in engagement that students exhibit as they move up in grade level.
- Administrative support and ongoing involvement of school and district administrators is critical to the sustainability of the initiative.
- One of the driving forces for sustainability and scaling up of the successful aspects of the program is parental and community support.
- Teachers need to experience and internalize 21st Century Learning if they are to transform their classrooms into 21st Century Learning Environments.
- Access to digital content was critical to the success of the program. To expand Emerge, digital content must be freely accessible, of high quality, mapped to standards, and in a multi-media format that students find engaging.
- The transformation of a classroom from traditional teaching to 21st Century Learning happens incrementally, at a number of levels, and requires time to mature.
- While the Emerge programs included a range of professional development models including: job-embedded professional development, online and face-to-face communities of practice and in school coaching and mentoring, teachers found the peer interactions with other teachers to be most valuable.
- Key to the progress of the Emerge one-to-one laptop implementation was the collaborative problem solving among curriculum, instruction, and technology professionals in order to tackle key issues and challenges.
- The capacity building (i.e., communities of practice, formative assessment reports, professional development, technical support, facilitation of discussions among technology directors and curriculum directors, etc.) throughout the three years was a strong factor in the progress accomplished by Emerge.

The major findings listed below represent the Trends from Year 1 to Year 3 for each research question, with data collected and analyzed at time points across the three years.

> *Perhaps the greatest accomplishment [from Emerge] is that, through the constant urging of the One-to-One group, the District has taken a renewed '"District-wide'" focus on "improved student learning through enhanced instruction." This should certainly be a vehicle for sustaining the instructional practice aspect of the project.*
>
> *- Emerge Project Lead*

Table 1: Findings and recommendations

[illegible]	[illegible]	[illegible]
What are the potential educational benefits of one-to-one laptop learning?	Finding 1.1. By the end of Year 3 there was a significant shift in Emerge classrooms toward 21st Century Learning Finding 1.2. Student engagement levels were fairly high at baseline. A cross-sectional analysis of all student data saw an increase over the three years of the project, with significantly higher engagement levels at elementary (Grades 3-5), than secondary (Grades 6-12). Finding 1.3.The current literature on student engagement in Canada (D. Willms et al., 2009), indicates decreases in student engagement after Grade 5 as students progress through school. The students in the Emerge program consistently arrested those predictions, negating a significant portion of the expected decline. Finding 1.4. While the cross sectional analysis of self-directed learning levels in Emerge were consistently positive, the longitudinal analysis showed a small, but statistically significant decline in self-direction for Emerge students. Finding 1.5. Overall, Emerge students significantly increased their readiness to thrive in a complex, global, high-tech society. They increased their levels of expertise with 21st Century Skills, and their teachers increased the frequency at which technology was used to engage students in deep, complex, authentic and relevant learning activities. This represents a strong beginning for the provincial advancement of 21st Century Learning.	Alberta Education should continue to provide leadership in the assessment of 21st Century Learning within technology enhanced learning environments, explicitly addressing the alignment with the content areas. A systemic approach to assessment of the 21st Century Skills and 21st Century Learning will be essential to achieve success. Alberta Education should continue to provide structures to inform practice for student self-direction. The slight decline across the years for Emerge students suggests that this will require whole schools or grade bands of teachers to systematically use techniques that advance high self-direction in all students. School jurisdictions should continue to build capacity to mature and scale student-centered, inquiry-based approaches to learning. School jurisdictions should continue to support and scaffold the development of 21st Century Skills within the context of knowledge building through inquiry and authentic learning.

[illegible]	[illegible]	[illegible]
What are the technical merits and innovative practices in one-to-one laptop learning?	Finding 2.1. In many schools, the Emerge program was expanded to other grades as early as the second year of the program to accommodate continued use by teachers who shifted classroom practices to incorporate technology and wanted to continue, and to ensure that students with one year of laptop learning could continue in subsequent years. Finding 2.2. Wireless networks established by the Emerge programs provided a well-resourced pilot for wireless networks that will inform future jurisdictional plans and investments. Finding 2.3. The level of technical support to launch a project such as Emerge is fairly intense, but decreases somewhat over time as teachers become more familiar with the technologies and as the stability and reliability of the network increases. Finding 2.4. The one-to-one access by students to technology devices has been a central focus of the Emerge program. The take-home policy for the devices varies by jurisdiction, often in response to variations across communities. Finding 2.5. The reliability of Emerge schools' access to the Internet was rated as excellent or good according to 69% of teachers and 74% of administrators.	Alberta Education should continue to provide support and direction for innovative models with regard to emerging technologies to support 21st Century Learning in Alberta schools (e.g., student-owned devices, wireless networks, etc.) and associated policies. School jurisdictions should continue to support, maintain, grow and sustain the technical infrastructure, associated technologies and peripherals, and technical assistance beyond Emerge classrooms and schools. School jurisdictions should continue to ensure robust infrastructure is in place to support the expansion of student owned devices. School jurisdictions should continue the intense collaborations among technical and educational teams to ensure the best technology environments for students and staff.

What expertise, experience, and lessons learned have come from the Emerge One-to-One Laptop Learning Project in Alberta?	Finding 3.1. The Emerge educators (teachers and administrators) have made steady progress in their proficiency with technology and 21st Century Learning. That expertise is translating into creativity and innovation in instructional practices in the classroom that better utilize the capacity of the technologies for learning, especially for those educators who were involved in Emerge for multiple years. Finding 3.2. While the Emerge program was designed as a three-year program, some jurisdictions designed their program to have the laptops follow the students. In some cases that meant new teachers joined Emerge each year, resulting in a one-year program for them. According to the Emerge principals, most teachers needed the multiple years of experience to accomplish the necessary shifts in practice and belief. Finding 3.3. The Emerge programs include a range of professional development models. One of the most highly valued by teachers and project leads was the community of practice, linking Emerge teacher to Emerge teacher. Finding 3.4. The key shifts in students are in technology literacy and efficacy, in their independence in learning, their increased collaboration, and their engagement in deep learning. Finding 3.5. The primary assessment of 21st Century Skills and Learning in the Emerge program is achieved by the use of rubrics (e.g., for students' digital projects, authenticity, engagement, critical thinking, collaboration, etc.). Finding 3.6. Student engagement and jurisdictional readiness are most significantly correlated in 21st Century Skills and Accountability. Finding 3.7. School administrators and teachers give high marks to the Emerge program for the insights gained in laptop and mobile learning. They are using these lessons to sustain and expand key elements of Emerge. Finding 3.8. A number of lessons learned have surfaced from the three-year Emerge program related to the potential of the technology for augmenting learning, engaging students, and increasing learning. See above, page vii.	Alberta Education should continue to support a community of learning for the sharing of expertise, experience and lessons learned from Emerge with other Alberta educators, (i.e., common area for sharing and continue to share, continued provincial opportunities to meet face-to-face and/or online to share.) School jurisdictions should continue to grow and support policies and models that have developed through Emerge with regard to technology integration and professional development in support of 21st Century Learning within technology enhanced environments. School jurisdictions should continue to grow and support professional development models that foster 21st Century Learning and technology integration, especially the embedded coaching and mentoring professional development models, When multiple year grants are awarded, to ensure maximum success, jurisdictions should consider involving the same educators in multiple years in order to maximize long-term, sustainable change.

Question 4	Findings	Recommendations
What is the level of jurisdictional and provincial readiness for systemically advancing 21st Century Learning and effective uses of technology in learning?	Finding 4.1. Over the course of the three years, the readiness of the Emerge programs for advancing 21st Century Learning and effective uses of technology have steadily increased. Finding 4.2. Over the course of the three years, Emerge teachers and administrators have developed a deeper understanding of and commitment to the vision for 21st Century Learning in their respective Emerge projects. Finding 4.3. Most of the Emerge school leaders have maintained strong support for Emerge one-to-one laptop learning throughout the program, while support from others has waned. Finding 4.4. Over the course of the first three years of Emerge, the perception of teachers as to the relevance of the 21st Century Skills to content has shifted from highly valuing productivity and communication to more highly valuing the use of tools in critical thinking, creativity, and ethical use. Finding 4.5. Classroom practices in the Emerge Project have shifted during the first three years toward 21st Century Learning, while maintaining a modicum of traditional, didactic teaching. Finding 4.6. Nearly a third of Emerge teachers indicated that interactions with students' parents are "strongly facilitated by technology." Finding 4.7. Teacher proficiency with technology in advancing academic proficiency and 21st Century Skills has increased over the three years of Emerge. Finding 4.8. Emerge teachers and administrators report having adequate access to computers and other peripherals, but do report some gaps in the access to more specialized technologies and to ongoing supplies (e.g., batteries, etc.). Finding 4.9. While the majority of Emerge teachers report having access to fast reliable Internet connections, there remains a significant percentage (29%) of Emerge teachers who report less than adequate access. Finding 4.10. The percentage of teachers who reported their students clearly understood what would be required to demonstrate their attainment of 21st Century Skills increased from Year 1 to Year 3. Many teachers are using rubrics for the assessment for and of 21st Century Learning.	Alberta Education should continue to provide a structure to allow for the expansion of the virtual communities of practice concept to promote collaboration and exchange of ideas for educators across the province. Alberta should continue to focus projects on advancement of student engagement, focusing on both 21st Century Learning and Assessment/Accountability. Alberta Education should continue to track and report readiness dimensions for 21st Century Learning, especially the 21st Century Skills and Accountability dimensions that were significantly correlated to student engagement. Alberta Education and school jurisdictions should continue to document and share best practices of curriculum, instruction and assessment practices with educators who are advancing practice in 21st Century Learning within technology enhanced learning environments.

Additional research is necessary to document and understand the long-term impacts of the Emerge initiative on teachers and teaching, students and learning, and on schools.

Project Background

The Emerge One-to-One Laptop Learning Project is a three-year Alberta Education Project. It was designed by the provincial government, in collaboration with publicly funded school jurisdictions and post-secondary institutions in Alberta, as a systematic research study of laptops in the classroom. In the fall of 2006, Alberta Education issued a Call for Proposals for jurisdictional, one-to-one mobile computing, as a formal announcement of the project. The Call for Proposals required that applicants focus on one of two themes: (1) Enhancing teaching and learning for specific student populations, or (2) Improving student learning in targeted areas.

In an effort to advance the capacity of the school jurisdictions to conceptualize such projects, Alberta Education hosted a laptop learning symposium on October 30, 2006 in Edmonton, Alberta, for interested jurisdictions. The symposium, *Laptop Learning: Essential Conditions for Success*, featured international speakers, discussion forums, and a research document on one-to-one laptop learning (compiled by Alberta Education). At the completion of the competitive process, Alberta Education awarded 20 jurisdictional Emerge projects.

Currently identified as the Emerge One-to-One Laptop Learning Project, it includes jurisdictions from across the province as shown in Figure 7. Based on initial estimates, the project anticipated impacting 2,502 students, 173 teachers, and 47 administrators within 50 schools in the 20 jurisdictions. (NOTE: The number of students impacted has increased due to the decisions by some of the jurisdictions to keep the laptops at a specific grade level, thus enabling new groups of students to use them each year. The other jurisdictions had the laptops follow the students. Thus the number of educators and students participating in the evaluation varies considerably across jurisdictions as well as time points.)

Alberta Education issued a Research Request for Proposals on January 11, 2007, for an evaluator/researcher for the project. Through a competitive process, that contract was awarded to a partnership between the Metiri Group, a U.S. based company, and the University of Calgary, Alberta. The Metiri/University of Calgary proposal included a mixed-methods evaluation. Metiri Group and the University of Calgary, hereafter referred to as the evaluation team, introduced the five research questions referenced above to augment those posed by Alberta Education.

The first year (school year 2007-2008) involved many technical and logistic challenges as the wireless systems in each of the 50 schools were installed. Laptops were assigned to students and teachers; policies were established; technical assistance was provided; teachers and administrators attained expertise and insight through professional development experiences; and the learning with laptops began in classrooms across the province.

The second and third years (school years 2008-2009 and 2009-2010) registered a shift in emphasis from the technology to a renewed focus on how the technology could advance learning and increase student engagement.

In June 2010, staff and students from 20 jurisdictions throughout Alberta completed the third year of Emerge. As with the two earlier evaluations, the Year 3 evaluation addresses the effect of the Emerge Project on participating students and explores the integration of instructional technologies by classroom teachers.

Figure 7. Map of participating jurisdictions

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#	School/District
1	Battle River Regional Division
2	Black Gold Regional Division
3	Calgary Roman Catholic Separate School District
4	Calgary School District
5	Chinook's Edge School Division
6	Edmonton Catholic Separate School District
7	Edmonton School District
8	Elk Island Public Schools Regional Division
9	Greater So. Separate Catholic Francophone Education Region
10	Greater St. Albert Catholic Regional Division
11	Lakeland Roman Catholic Separate School District
12	Medicine Hat School District
13	Northern Gateway Regional Division
14	Palliser Regional Division
15	Peace River School Division
16	Prairie Land Regional Division
17	Rocky View School Division
18	St. Paul Education Regional Division
19	Westwind School Division
20	Wolf Creek School Division

Evaluation Design

The objectives of the three-year evaluation of Emerge, as identified by Alberta Education at the inception of the program were to:

- Establish and support a research-based, one-to-one laptop learning community of practice.
- Further investigate the potential educational benefits of one-to-one laptop learning.
- Identify technical merits and innovative practices in one-to-one laptop learning.
- Share expertise, experience and lessons learned related to one-to-one laptop learning.
- Inform and support one-to-one laptop learning implementations within Alberta's learning system.

Methodology

With those purposes in mind, a longitudinal, mixed-methods design, encompassing both qualitative and quantitative data, was employed to evaluate the progress and outcomes of the Emerge project. The design involved an initial alignment of indicators and measures based on the following five research questions:

1. What are the potential educational benefits of one-to-one laptop learning?
2. What are the technical merits and innovative practices in one-to-one wireless learning?
3. What expertise, experience, and lessons learned have come from the Emerge One-to-One Laptop Learning Project in Alberta?
4. What is the level of jurisdictional and provincial readiness for systemically advancing 21st Century Learning and effective uses of technology in learning?
5. What are the trends and/or variances across indicators over time?

The data were collected annually from teachers, administrators, students, and project leads using the following measures:

1. *Online surveys.* Survey data was collected from teachers, students, administrators, and points of contact (POCs). Dimensions21 (D21) ™, a suite of surveys developed by Metiri Group, gauges the level of technology integration and proficiencies, as well as a school or district's current readiness to implement 21st Century Learning. D21™ was administered annually in Spring 2008, Spring 2009, and Spring 2010 to all participating teachers and principals. Additional measures, administered to students annually as pre and post measures in Fall and Spring, included the Self-directed Learning Inventory (SLI), the Student Engagement Survey, and the Classroom Structures to Engage Students (CSES).
2. *Interviews and focus groups.* Site visits were conducted at schools in all 20 participating jurisdictions by members of the evaluation team in Fall 2007, Spring 2008, Spring 2009, and Spring 2010. These visits included interviews and focus groups with school personnel, students, and parents.
3. *Classroom observations.* Several classroom observations were conducted during each site visit.
4. *Student artifacts.* Various student-produced artifacts were analyzed and scored by the evaluation team.

Participants in the Emerge Project were surveyed one to four times over a period of 3 years, depending upon when they entered the program. Table 2 reports the total number of respondents by measure at each time point.

Table 2. Total number of respondents by survey: Fall 2007-Spring 2010

Measure	Fall 2007 *N*	Fall 2008 *N*	Spring 2009 *N*	Fall 2009 *N*	Spring 2010 *N*
Students					
Classroom Structures to Engage Students (CSES)	1,772	684	1,699	635	1,612
Student Engagement	1,604	634	1,619	615	1,550
Self-directed Learning Inventory (SLI)	1,428	302	1,379	415	1,409
Teachers					
Dimensions21 Teacher	108		129		116
Administrators					
Dimensions21 Administrator	46		46		53

NOTE: The fall surveys were intended as baseline data collection for incoming participants, thus involving lower numbers of respondents.

Overall, data were collected from approximately 3,500 students at least once throughout the project's duration. In addition, over the course of three years, annual site visits were conducted in 20 jurisdictions.

Organization of Report

This report is organized around the first four research questions. The executive summary provides succinct answers to those four questions based on a triangulation of data across the three years of the Emerge project. The main report provides a background of the Emerge project, followed by the evaluation design and the methodology. Then, each of the research questions is addressed in a separate section. The Appendices offers a full review of 21st Century Skills and References.

Question 1: Potential Educational Benefits

Research question: What are the potential educational benefits of one-to-one laptop learning?

An objective of the Emerge Project was to explore the efficacy of one-to-one laptop computing in achieving deep learning and attaining higher levels of expertise in 21st Century Skills. This evaluation report provides evidence and analysis of trends in these areas.

Overall results suggest that system changes are underway in Emerge classrooms toward more student-centered, experiential learning, especially in Grades 4 and 5. In addition, there is some evidence of positive impacts on students related to student attainment of 21st Century Skills and student engagement.

Potential Educational Benefits

The potential educational benefits of one-to-one laptop learning are high levels of:

- Attainment of 21st Century Skills
- Engagement of students in deep, complex, relevant learning
- Self-directed learning
- Readiness of students to thrive in a complex, global, high tech society
- Authenticity of student learning and complexity of student thinking

The potential educational benefits of one-to-one laptop learning are listed in the box above. The evidence basis for these potential benefits in Emerge can be found below, and under Question 4 on System Readiness. In addition, at the end of this section, the researchers have provided recommendations for consideration by Alberta Education and the Alberta education system for future initiatives.

Attainment of 21st Century Skills

There are calls from business, industry, government, and community, for education to prepare graduates to contribute to economic viability locally and nationally. Education is under fire to prepare graduates for a highly collaborative, innovative, high tech, global workforce. For example, a 2009 research study in the U.S. identified causal links between high cognitive teaching and learning in schools and the economic growth and health of states and nations (Hanushek & Woessman, 2009).

Finding 1.1

By the end of Year 3 there was a significant shift in Emerge classrooms toward 21st Century Learning.

A major goal of Emerge, and what the evaluation team deems its greatest success, was the promoting of 21st Century Skills, integrated into the content areas. At the inception of the Emerge Project, the 20 jurisdictions committed to a focus on 21st Century Skills, but discussed 21st Century Skills in general, rather than zeroing in on specific goals. During the first year of the project the Emerge participants became more knowledgeable about the range of 21st Century Skills, and narrowed their focus to just a few skills. The most common of those were *Critical Thinking, Teaming and Collaboration,* and *Self-directed Learning*. The full set of 21st Century Skills is represented in the enGauge framework in Figure 8 below.

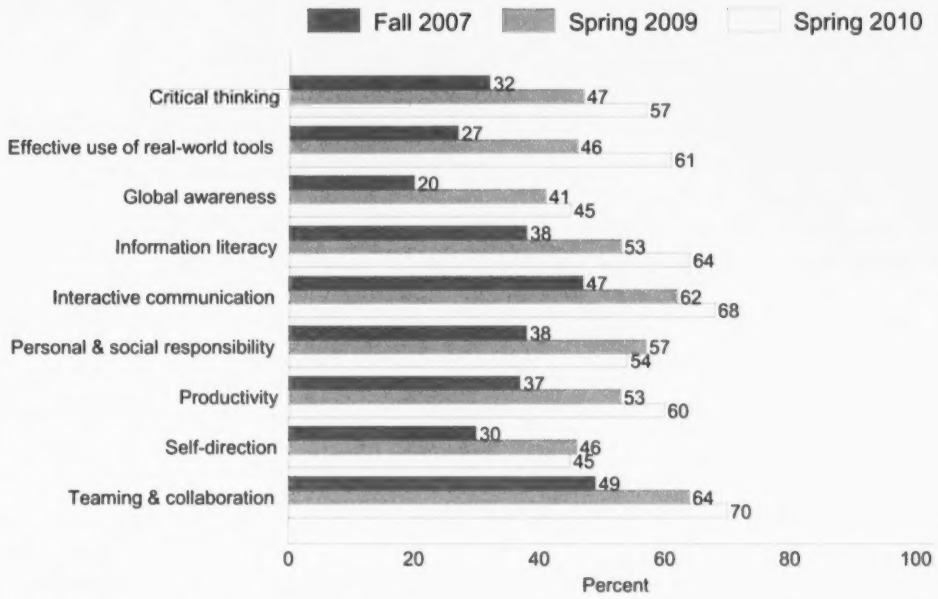
Figure 8: The enGauge framework of 21st Century Skills

SOURCE: Metiri Group and the U.S.-based North Central Regional Educational Laboratory

Sixty percent of Emerge teachers indicated that their students had reached Intermediate or Expert levels in at least five of the 21st Century Skills.

Emerge has been relatively successful in advancing student attainment of some of these 21st Century Skills. Teachers indicated that their students had begun acquiring these 21st Century Skills through Emerge. As Figure 9 shows 60% of the teachers indicated that their students had reached Intermediate or Expert levels in five of the 21st Century Skills. Given that most jurisdictions concentrated on only a few 21st Century Skills, the overall average attainment is higher than might be expected.

Figure 9: Percentage of teachers' ratings at the Intermediate or Expert level for students' 21st Century Skills attainment



SOURCE: Teacher survey. Fall 2007, *n*=108; Spring 2009, *n*=129; Spring 2010, *n*=116.

The following anecdotes from the site visits at Emerge schools bring to life the 21st Century Learning that has been accomplished in some of these schools:

Personalized learning

In one junior high school science class, Emerge students used the capacity of multimedia in support of their learning. Students had completed a survey to determine their preferred ways of learning, which was mapped to Howard Gardner's work on multiple intelligences. Using this information, students then personally designed their review process for their upcoming exam on the electricity unit of study. Students selected various digital applications or paper/pencil based on their preferred learning style as to how they would review the materials for the exam on this unit of study.

For example, two students whose preferred way of learning was auditory and visual, created a podcast in which they video recorded one of them explaining the steps in calculating an equation as it was solved on the whiteboard. This podcast was to be posted in Moodle. A second example involved students using Paint and/or SMART Notebook to create visual representations of key information. A third example had students creating flash cards or a paper poster where information was presented in a way that helped students study for the exam. As students reviewed the content for the exam, they accessed information from the textbook and electronic files (MS Word or PowerPoint). Having access to digital technology allowed these students to review course materials using their preferred learning styles within a multi-modal learning context.

Virtual Worlds, Virtual Wetlands

In Grade 5, students learn about wetland ecosystems by studying life in a local pond, slough, marsh, fen or bog. Through classroom studies, and studies in the field, students learn about organisms that live in, on and around wetlands and about adaptations that suit pond organisms to their environments. Students also learn about the interactions among wetland organisms, the role of each organism as part of a food web, and the role of human action in affecting wetland habitats and populations.

This study took a unique twist in an Alberta Grade 5 science classroom when they investigated types of wetlands by creating virtual wetlands in an online Kodu environment. (Kodu is a resource that enables students to create virtual worlds, avatars within those worlds, and rules by which the virtual systems operate.)

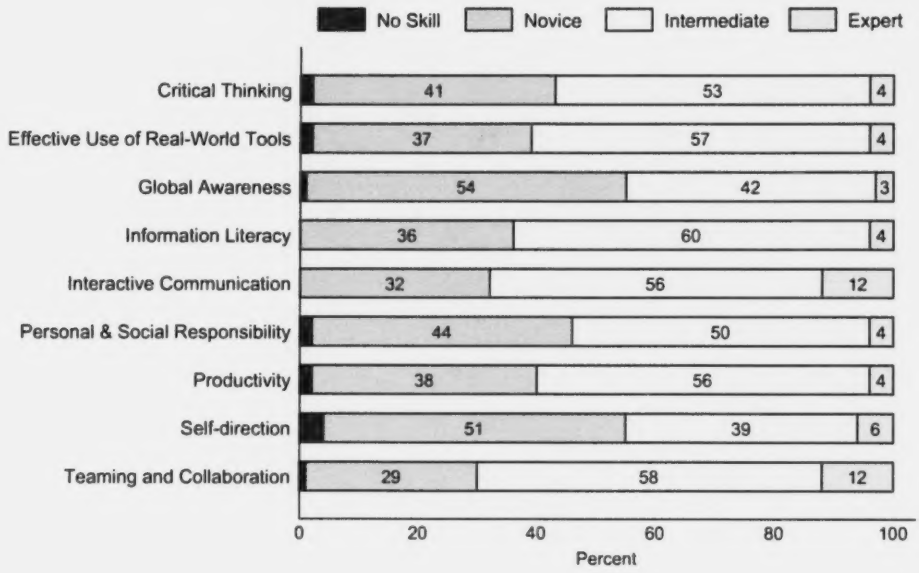
Students were introduced to Kodu by experts from Microsoft, and to wetlands through a Webquest their teacher had developed. It used web links, resources, videos, and games to build their knowledge base on wetlands. Once they had a rudimentary knowledge, they began to organize their ideas by planning how they would build those worlds, including the types of wetlands to represent and the interactions that would take place in the wetlands. Beginning with a blank world, they added and customized various types of wetland to include types of plant life, cloud/weather formations, animal life, type of water, and the interactions that take place.

During the building and programming of the wetlands, students worked in pairs helping each other and sharing programming skills that they might have discovered. For example, students wanted to make the clouds in one environment rain. Once one student had figured out how to program clouds, that student came up to the smart board and demonstrated it to the rest of the class. This was a unique experience for the class since the teacher was no longer the source of all knowledge. They had to be working together to discover more about the program and what they could do with it. The students deepened their understanding of wetlands as they expanded their use of digital tools.

A great deal of progress was made in student attainment of 21st Century Skills during this three-year Emerge Project.

Figure 10 demonstrates the progress that can be made within projects that focus on these skills when they adequately resource their classrooms and support their teachers for 21st Century Learning. Despite that growth, a significant number of Emerge students remain novices in their use of 21st Century Skills.

Figure 10: Percentages of teachers' ratings of student attainment of 21st Century Skills at the end of the project



SOURCE: *Teacher surveys, Spring 2010, n=116*

While Emerge accomplished significant growth in students' 21st Century Learning, the province has much yet to accomplish in the realm of 21st Century Learning.

In reviewing the potential benefits of laptop learning, the Emerge evaluation also looked at student engagement and student self-directed learning. The upcoming sections first discuss the methods of analysis of the student data and then report the results.

Methods of analysis of student data

In order to answer the research questions listed above, the evaluation team used two types of evidence to draw inferences about the impact of Emerge: (1) *cross-sectional data*—measures of association between participation in Emerge and behaviors at the time data were collected; and (2) *longitudinal data*—measures of association, for students who were observed at multiple points in time.

Cross sectional sample

The cross sectional analyses include all students from all data points in the Emerge One-to-One Laptop Learning Project. These analyses are meant to give the reader a snapshot of how engaged and self-directed the students in the Emerge project were at different points in the study.

Longitudinal sample

In addition to looking at data collected from all students in Emerge across years, we identified a subset of these students for further analysis. These students, who were surveyed in multiple years, are referred to as the *longitudinal sample*. Collecting longitudinal data allows for strong evidence of within-student changes in behavior and beliefs over time. However, in comparison to using all students, the use of the longitudinal sample for analysis has the following two disadvantages: it reduces the sample size; and it limits the generalizability of the conclusions.

Students in the longitudinal sample were then classified in either the *1 Year in Emerge* group or *2 Years in Emerge* group, depending on when they entered the program, and the length of their participation. Additional information on these groupings is provided below.

1 Year in Emerge group. Students included in the *1 Year* group are students who completed one *full* year of the Emerge One-to-One Laptop Learning Project; this includes students who began in Fall 2007 and ended in Spring 2009; students who began in Fall 2008 and ended in Spring 2009; and students who began in Fall 2009 and ended in Spring 2010. The students in the first group, Fall 2007 to Spring 2009, are included in the 1 Year group because the school year Fall 2007 to Spring 2008 was not a complete year of the project and therefore their experiences would most accurately group with students who only participated for a year.

2 Years in Emerge group. Students included in the *2 Years* group are students who began in Fall 2007 and completed the entire Emerge Project ending in Spring 2010, as well as students who began in Fall 2008 and ended in Spring 2010. When interpreting this analysis, it is important to note that the students included are in the longitudinal analysis are only students with multiple data points as outlined in the methodology section.

Student engagement

For the purposes of this work, student engagement is defined as, "the degree to which students are actively pursuing deep learning related to established standards" (Fredricks, Blumenfeld, & Paris, 2004). Deep learning is defined as, "learning that involves the critical analysis of new ideas, linking them to already known concepts and principles, and leads to understanding and long-term retention of concepts so that they can be used for problem solving in unfamiliar contexts" (Higher Education Academy Engineering Subject Centre, 2010).

Finding 1.2

Student engagement levels were fairly high at baseline. A cross-sectional analysis of all student data saw an increase over the three years of the project, with significantly higher engagement levels at elementary (Grades 3-5), than secondary (Grades 6-12).

Student Engagement Survey

The Metiri Group developed a *Student Engagement* survey to measure the degree to which students perceive themselves cognitively or affectively involved with the overall tasks and activities in the class. The survey classifies students, based on their responses to several statements, into the five distinctive levels of engagement: Intrinsically Engaged, Tactically Engaged, Compliant, Withdrawn, and Defiant (Fredricks, Blumenfeld, & Paris, 2004; Schlechty, 2002). Distinguishing characteristics of student behavior within each level are included below.

Finding 1.3

The current literature on student engagement in Canada (D. Willms, S. Friesen, & P. Milton, 2009), indicates decreases in student engagement after Grade 5 as students progress through school. The students in the Emerge program consistently arrested those predictions, negating a significant portion of the expected decline.

Intrinsically engaged students

- Student sees the activity as personally meaningful.
- The student's level of interest is sufficiently high that he persists in the face of difficulty.
- The student finds the task sufficiently challenging that he believes he will accomplish something of worth by doing it.
- The student's emphasis is on optimum performance and on "getting it right."

Tactically engaged students

- The official reason for the work is not the reason the student does the work, she substitutes her own goals for the goals of the work.
- The substituted goals are instrumental—grades, class rank, college acceptance, and parental approval.
- The focus is on what it takes to get the desired personal outcome rather than on the nature of the task itself—satisfactions are extrinsic.
- If the task doesn't promise to meet the extrinsic goal, the student will abandon it.

Compliant students

- The work has no meaning to the student and is not connected to what does have meaning.
- There are no substitute goals for the student.
- The student seeks to avoid either confrontation or approbation.
- The emphasis is on minimums and exit requirements: "What do I have to do to get this over and get out?"

Withdrawn students

- The student is disengaged from current classroom activities and goals. The student is thinking about other things or is emotionally withdrawn from the action.
- The student rejects both the official goals and the official means of achieving the goals.
- The student feels unable to do what is being asked, or is uncertain about what is being asked.

Defiant students

- The student is disengaged from current classroom activities and goals.
- The student is actively engaged in another agenda.
- The student's rebellion is usually seen in acting out—and often in encouraging others to rebel.

The number of students who took the student engagement survey, by time point, are included in Table 3. The Total *N* row represents the complete sample of students (the cross-sectional sample), whereas the longitudinal sample represents the subset of students, measured at multiple time points.

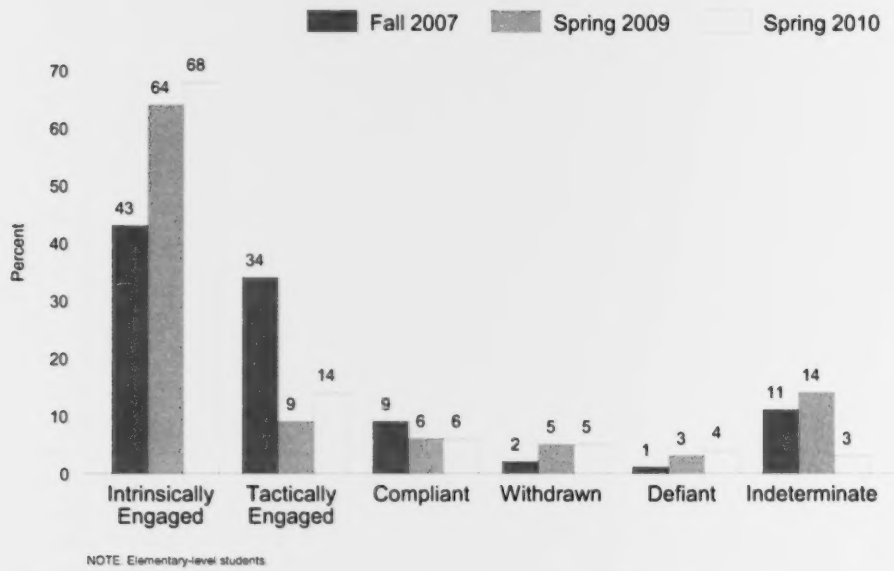
Table 3: Total student engagement respondents by time

	Fall 07	Fall 08	Spring 09	Fall 09	Spring 10
Total *N*	1604	634	1619	615	1550
Longitudinal *n*	584	499	627	491	947

Major Findings: Cross sectional student engagement analysis

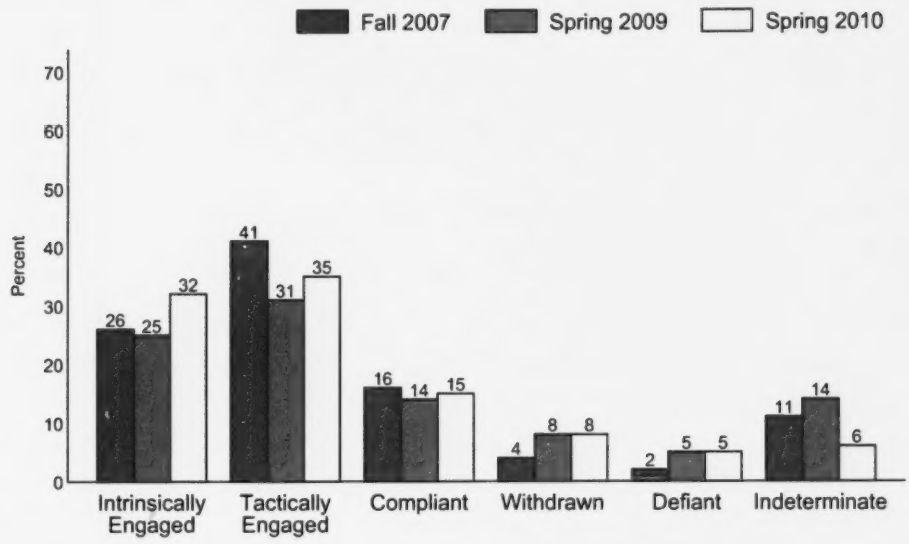
The figures below illustrate the shift in overall engagement levels among all elementary and all secondary students in the Emerge project from Fall 2007 to Spring 2010. Elementary students, on average, rated themselves as more intrinsically engaged in Spring 2009 than Fall 2007 and this trend stayed consistent in Spring 2010. Further, elementary students in the Emerge project seem to have become less tactically engaged over the years but slightly more defiant. Similarly, the total population of secondary students in the Emerge project also became more intrinsically engaged and less tactically engaged over the duration of the study but to a lesser degree than the elementary students.

Figure 11: Cross sectional student engagement for elementary students (Grades 3-5)



Sources: Student engagement surveys. Fall 2007, *n*=948; Spring 2009, *n*=580; Spring 2010, *n* = 374.

Figure 12: Cross sectional student engagement for secondary students (Grades 6-12)



NOTE: Secondary-level students.

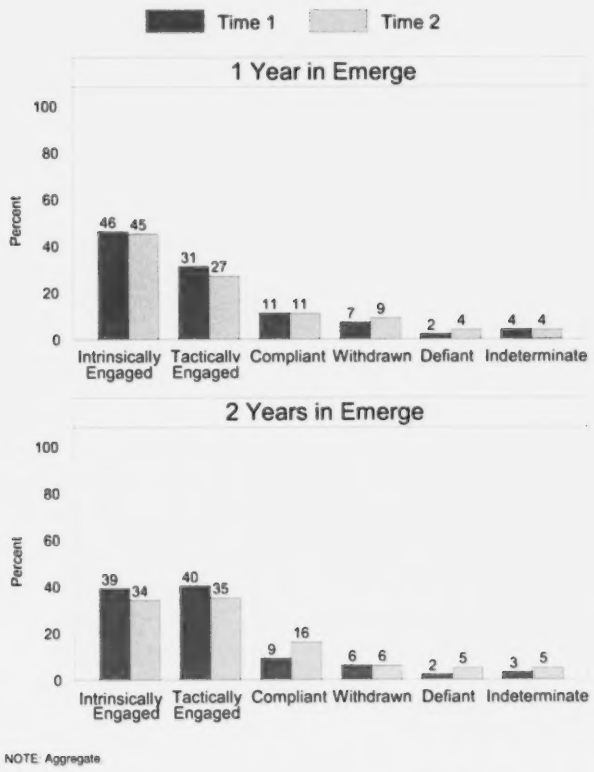
Sources: Student engagement surveys. Fall 2007, *n*=773 ; Spring 2009, *n*=1209 ; Spring 2010, *n* = 1188

While informative, this cross sectional analysis compares different groups over time, and can only be used to note general trends over time. From this analysis, we see consistently high engagement levels over time and we see that elementary engagement levels are consistently higher than secondary engagement levels over time.

Major Findings: Longitudinal student engagement analyses

Shifting gears to focus on students who were surveyed in multiple years, on the whole, there was a very slight change in student engagement levels across the years.

Figure 13. Percentage of students in each engagement

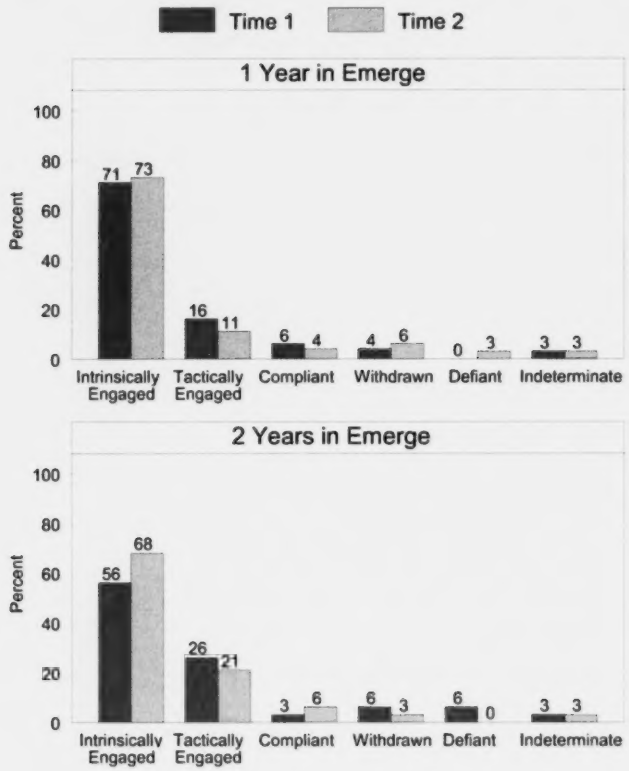


NOTE: 1 Year [in Emerge] *N*=1,118; 2 Years *N*=456.

The majority of the movement seen in the overall engagement results for the students in the longitudinal sample can be seen in the elementary students and the students who transitioned from elementary to secondary. The elementary students did exhibit an increase in their identification as *Intrinsically Engaged* and the transition students did show a decrease in their identification as *Intrinsically Engaged.* Very little change can be seen in the secondary students who were part of the longitudinal sample.

As shown in Figure 13, there was not a lot of change from Time 1 to Time 2 for the students in the *1 Year* group (*n*=1,118). It is important to note that overall nearly half of the students who participated in Emerge for a year were *Intrinsically Engaged* at both time points. Compared to the students in the *1 Year* group, the students in the *2 Years* group (*n*=456) were less *Intrinsically* and *Tactically Engaged.* Further, in Time 2, a higher percentage of these students were classified as *Compliant* and slightly more *Defiant* compared to Time 1.

Figure 14. Percentage of elementary-level students in each engagement level



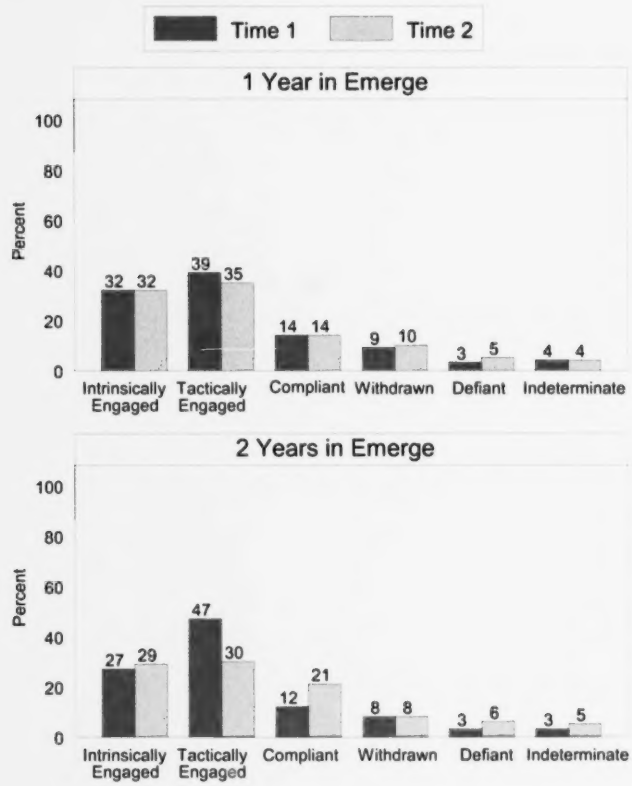
NOTE: Elementary-level students.

NOTE: 1 Year [in Emerge] Elementary *N*= 358; 2 Years *N*=34.

From Time 1 to Time 2, elementary students in the *1 Year* group rated themselves as more *Intrinsically Engaged*, less *Tactically Engaged*, and less *Compliant*. Although there was a shift in students rating themselves as more *Withdrawn* and *Defiant* than in Time 1, this shift was very slight. (*n*= 358)

Interestingly, the elementary students in the *2 Years* group exhibited gains in their *Intrinsically Engaged* scores. (*n*= 34)

Figure 15: Percentage of secondary-level students in each engagement level



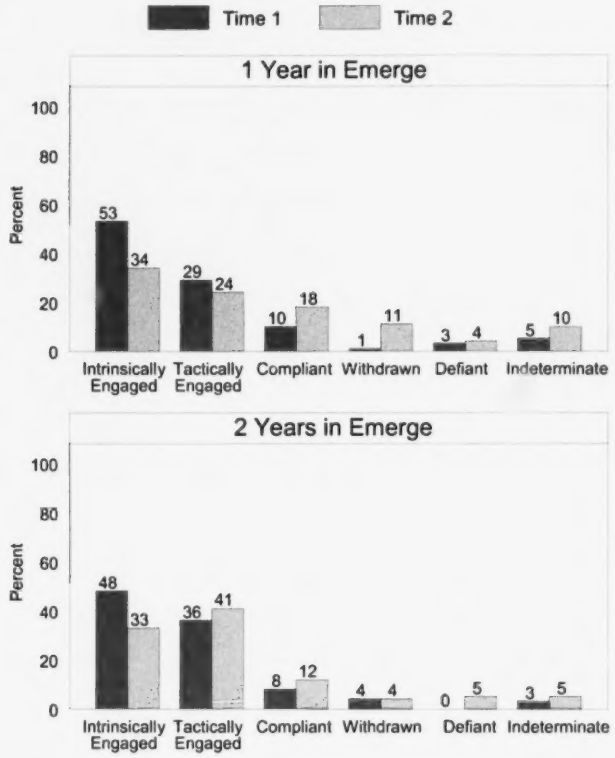
NOTE: Secondary-level students.

NOTE: 1 Year [in Emerge] Secondary *N*= 680; 2 Years *N*=210.

The majority of secondary students in the *1 Year* group were classified as either *Intrinsically Engaged* or *Tactically Engaged* and this classification did not shift majorly from Time 1 to Time 2. (*n*= 680)

The secondary students in the *2 Years* group demonstrated a more drastic shift from Time 1 to Time 2 than the secondary students in the 1 Year group. Although there was a slight increase in these students' *Intrinsically Engaged* scores, there was a large drop in their *Tactically Engaged* scores. (*n*= 210)

Figure 16. Percentage of transition students in each engagement level



NOTE: Transition.

NOTE: 1 Year [in Emerge] Transition *N*= 80; 2 Years *N*= 221.

Specifically addressing the set of students who transitioned from elementary to secondary between Time 1 and Time 2 in the *1 Year* group, there was a large shift in students being identified as *Intrinsically Engaged.* Overall in Time 2, these students were ranked as less *Tactically Engaged,* more *Compliant*, and more *Withdrawn* than they were during Time 1 administration. The students who are represented here are students who began in Fall 2007 and ended in Spring 2009. (*n*= 80)

Further, there was a drop in the *Intrinsically Engaged* scores and an increase in the *Tactically Engaged* scores and *Compliant* scores, among the transition students in the *2 Years* group. This pattern can possibly be attributable to the shift from being an elementary student to being a secondary student. (*n*= 221)

Classroom Structures to Engage Students (CSES)

The Classroom Structures to Engage Students (CSES) section of the student engagement surveys measured the degree to which students found the structures in their classrooms to be engaging. To that end, students answered 50 survey questions based on a 1 to 5 scale, ranging from "completely false" to "completely true." In general, higher scores reflect higher levels of student engagement, whereas low scores reflect student disaffection or disengagement. Scores greater than or equal to 3.5 imply that students perceive high levels of engagement. Moderate levels of engagement are reported for scores between 2.5 and 3.4. Scores between 1.5 and 2.4 represent low levels of reported student engagement. Scores below a 1.5 indicate that the students are not engaged (see Table 4).

Since student engagement is a multi-faceted construct, each item measures one of three conditions: students' rating of the how engaging they found the classroom Products, Processes, and Contents. Table 4 provides a few sample statements by condition.

Table 4. Examples of statements from each of the three scales

Product	*Process*	*Content*
The work we do in class will help me as an adult.	I often work with my classmates on projects.	The work we do in class is interesting and fun.
I work hard in this class because the work seems important.	My teacher and I discuss how good my work is.	The teacher understands what I am interested in and tries to include this in the things we do in class.
I understand what I need to do in class to be successful with my school work.	I discuss how good my work is with other students.	I am able to use things I learn in one subject to better understand another subject.
	The work we do in class results in a product I can show to my family or friends.	

The *Product* scale refers to the structures that enable students to rehearse, apply, extend, and demonstrate what he/she learned through a product, such as writing, illustrating, performing, or debating. The *Process* scale refers to the learning activities through which the student is able to make sense of, or master, the content. The *Content* scale refers to student opportunities to engage with academic subjects in ways that result in deep understanding of concepts, principles, and context. To create a single, overall engagement score, mean scores from all 50 statements were averaged.

Table 5 illustrates the total completion numbers for the student engagement survey by time point as well as the sample size for the longitudinal analysis that will be discussed in this student section. Make note of the percent of students from the total completion samples that were included in the longitudinal analysis, denoted in column "% matched."

Table 5: Total completion and longitudinal counts

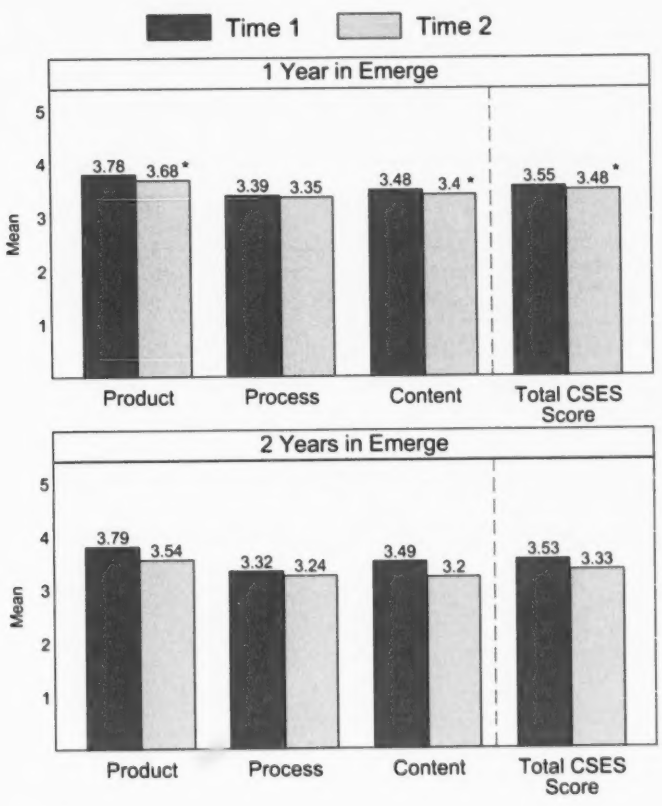
	Fall 07	Fall 08	Spring 09	Fall 09	Spring 10
Total *N*	1,772	684	1,699	635	1,612
Longitudinal *n*	690	534	682	536	1,078
% matched	39%	78%	40%	84%	67%

Major Findings: Classroom Structures to Engage Students

Similarly to the Student Engagement scores, there was a decrease in students' ratings of the engagement of their classroom structures. But the decrease seen in the Classroom Structures to Engage Students (CSES) scale, on a whole, were less than the decrease in the Student Engagement scores. This means that even though the students in the longitudinal sample, overall, rated themselves as less engaged while part of the Emerge project, the students' feelings on the engagement of their classrooms stayed relatively stable. More specifically, despite the slight decreases in CSES, students across all three levels feel their classrooms are, in general, moderately or nearly moderately engaging.

The following data points are included in the 1 Year and 2 Years group analyses for the Classroom Structures to Engage Students (CSES) engagement measure.

Figure 17: Mean scores for Product, Process, Content, and CSES Total



NOTE: Aggregate.

NOTE: * statistically significant at p <. 05. 1 Year [in Emerge] *n*= 1,218; 2 Years *n*= 542.

Overall, there was very little movement in the *1 Year* students' classroom engagement scale scores. These students view their classroom as engaging and this attitude does not shift much over their year in the Emerge Project. Scores greater than or equal to 3.5 imply that students perceive high to moderate evidence of classroom structures to engage them in learning. Scores lower than 3 indicate that students reported either low or moderately low evidence/quality of classroom structures that engage them. (*n*=1,218)

Overall, there was a significant drop in the classroom engagement scale scores and the composite scale, CSES Total for students in the Emerge Project for *2 Years*. (*n*=542)

Engagement results in context

In an effort to put the Emerge student engagement results into context, we located a Canadian study (Willms, J.D., Friesen, S. & Milton, P., 2009) with comparable outcomes. Our intent was for the reader to see the Emerge trend data on student engagement levels in comparison to the trend data for Canadian students nationally. The Canadian Education Association's "What did you do in school today?" national dataset (Willms, et al, 2009) reported changes in student engagement over time by grade level. Given that the Canadian Education Association's national

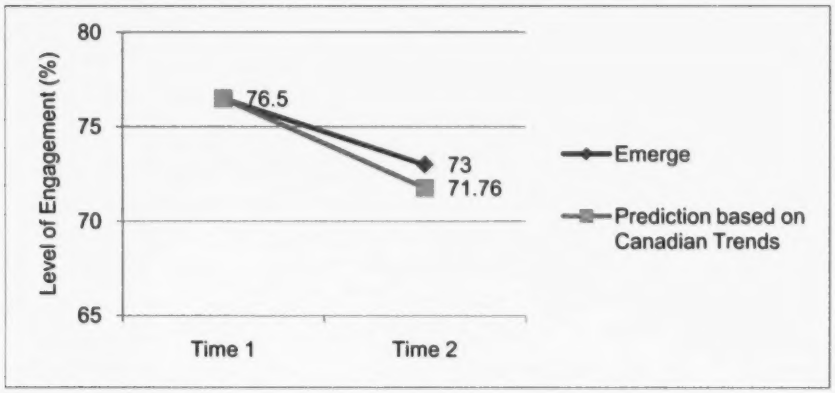
report, has a large sample size of 32,322 students, the change seen in their different engagement scores can be considered representative of Canada's change in engagement levels.[1]

The following tables display the results of our analysis. Overall, as seen in *Table 6*, the decrease seen in the students in the Emerge project in the *1 Year* and *2 Years* groups are less than what would be predicted by current trends in Canadian student engagement. This illustrates that the students in the Emerge project, despite their overall decrease in engagement scores, actually decrease to a lesser extent than expected of the population.

Table 6: Overall student engagement change results

Group	Emerge student engagement change	Expected Canadian student engagement change	Positive change potentially resulting from Emerge
1 Year group	-3.5%	- 4.73%	+1.23
2 Years group	-5.25%	-7.39%	+2.14

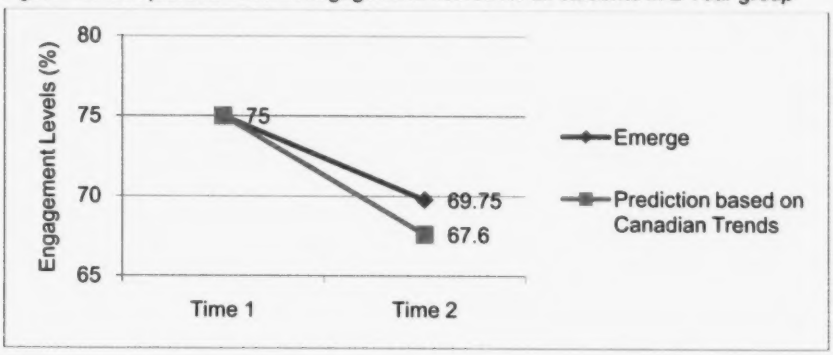
Figure 18. Comparison trend in engagement scores for all students in 1 Year group



SOURCE: Student Engagement surveys- all students. N=1,118

[1] To compare the scores, we applied the mean change in student engagement scores from each of the Emerge longitudinal samples to the change/decrease predicted by the Canadian study "What did you do in school today?" This, in essence, provides an expected change of a representative sample of Canada's student population that then can be used as a comparison to the actual change seen in the students in the Emerge project from Time 1 to Time 2. Specifically, we compared the expected Canadian student engagement change scores to the 1 Year and 2 Years groups overall and across grade levels, elementary and secondary.

Figure 19: Comparison trend in engagement scores for all students in 2 Year group



SOURCE: Student Engagement surveys. *N*=456

In the end, this analysis finds that the students in the Emerge One-to-One Laptop Learning Project have done better than anticipated when comparing them to the significant decreases seen in the sample from the "What did you do in school today?" study.

Discussion

Why did student engagement decrease or remain the same across years?

There are several possible explanations for the trend lines in the Emerge data. First, numerous studies have shown that student engagement in learning drops considerably as students get older (Anderman, Maehr, & Midgley, 1999). By the time students reach middle school, lack of interest in schoolwork becomes increasingly apparent among students, and by high school, too many students are not sufficiently motivated to succeed in school. Lumsden (1994) states that their desire to continue on a path of learning and exploring diminishes as they grow and progress through school. MacIver and Reuman (1994) add that middle school and high school-age students' level of engagement in school is also highly influenced by peers. As students grow older, their motivation to engage in learning may be influenced by their social group just as much as, if not more than, it is by teachers, parents, and other adults. While peer influences can be either positive or negative, it is not uncommon for older students to discourage one another from actively participating in school (MacIver & Reuman, 1994). In fact, the older students get, the less likely they are to take risks and engage themselves fully in activities at which they are not sure they will succeed. According to Lumsden (1994), "although young children tend to maintain high expectations for success even in the face of repeated failure, older students do not" (p. 2). To older students, "failure following high effort appears to carry more negative implications -- especially for their self-concept of ability -- than failure that results from minimal or no effort" (Lumsden, 1994, p. 2). In addition, according to researchers, while elementary students may accept low-level tasks, such as work sheets and drill and practice exercises, the middle school student, is much more likely to recognize such tasks as unchallenging and boring (Mergendoller, Marchman, Mitman, & Packer, 1988; Mitman, Mergendoller, Packer, & Marchman, 1984; Walberg, House, & Steele, 1973).

Student self-direction

A major goal of programs such as Emerge is for participating students to become self-directed learners. These skills are known to be important constructs in predicting the success of an individual on multiple types of tasks, including setting academic goals and performing well in school. Therefore, monitoring self-direction among students gives stakeholders an additional means to gauge the program's level of impact across years.

Finding 1.4

While the cross sectional analysis of self-directed learning levels in Emerge where consistently positive, the longitudinal analysis showed a small, but statistically significant decline in self-direction for Emerge students.

What is self-directed learning?

Self-directed learners are generally described as motivated participants who efficiently control their own learning experiences. This includes organizing and rehearsing information to be learned, and holding positive beliefs about their personal capabilities, the value of learning, and the factors that influence learning. For example, a student who believes earning a high grade in a difficult science course is achievable and persists in his or her efforts is considered a self-directed learner. Many social learning theorists suggest that self-directed learning processes and accompanying beliefs fall into three cyclical phases: *Forethought*, *Performance/Volitional control*, and *Self-reflection*. These three phases of learning, as outlined by Schunk and Zimmerman (1998), are described in more detail below.

The *Forethought* phase refers to processes and beliefs that precede e[illegible]o learn and establish the basis for learning. Examples of these processes include goal settin[illegible]planning, and numerous self-motivational beliefs such as self-efficacy and outcome expectations. The *Performance/Volitional control* phase refers to processes that help learners focus on the task and optimize their performance. Examples of these processes include self-control mechanisms (e.g., self-instruction, imagery, and attention focusing) and self-observation processes (e.g., self-recording one's behavior). The *Self-reflection* phase refers to processes associated with self-observations: Self-judgment and self-reactions. An example would be answering the question: Did I improve my behavior or performance? These self-reflections, in turn, influence forethought regarding future efforts—thus completing the self-directed learning cycle.

Instrument

The SLI is composed of 50 statements. It includes the following three scales: *Forethought*, *Performance/Volitional control*, and *Self-reflection*. Each scale has five to eight statements and students indicate how well each statement describes them. Each item presents a belief statement and students must indicate the degree to which they regard the statement using a 7-point scale, ranging from 1 ("this is *completely false* for me") to 7 ("this is *completely true* for me").

Major Findings: Cross sectional student self-direction

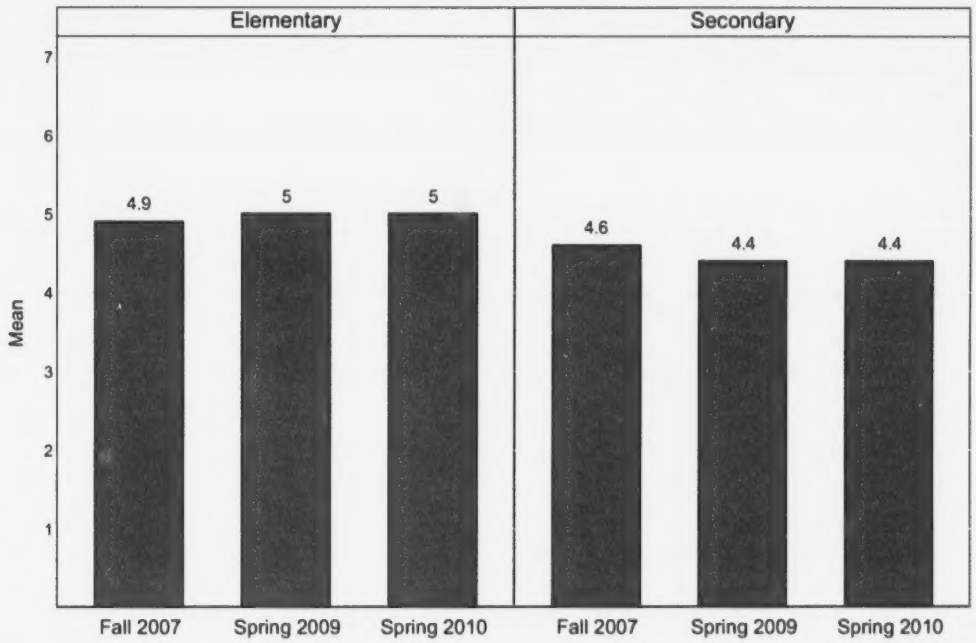
The following section presents scores indicating the degree to which students reported using self-directed learning strategies in learning. First, the mean scores from the cross-sectional analysis, which includes all participants across the three years of Emerge, will be presented.

Table 7. Number of respondents who took the SLI by level, across years

Level	Fall 2007	Spring 2009	Spring 2010
Elementary-level	810	432	437
Secondary-level	641	947	848

The composite SLI scores for elementary-level students showed a slight increase from Fall 2007 (M=4.9) to Spring 2010 (M=5.0) for all students in Emerge, as shown in Figure 20. The secondary-level students, however, showed a slight decrease from Spring 2007 (M=4.6) to Spring 2010 (M=4.4).

Figure 20. Total SLI mean scores for all students in Emerge: Fall 2007-Spring 2010



NOTE: Style of Learning Inventory (SLI) items measured on a 7-point scale. *N*s are reported in Table 7.

Longitudinal time series analysis: SLI scores

In addition to the trend analysis, a longitudinal time series analysis was also employed. [2] The number of students who took the SLI, by time point, is included in *Table 8*. The Total *N* row represents the complete sample of students (the cross-sectional sample), whereas the longitudinal sample represents the subset of data comprised of the same students, measured at multiple time

[2] In their book, *How to Design a Program Evaluation*, Fitz-Gibbon and Morris distinguish between the two types of time series analysis. They write: "Time series analysis comes in two varieties. One involves measurements of the same group of students. This can be called a longitudinal time series analysis, as to distinguish it from the more common variety, the successive time series" (p. 60-61). Longitudinal research has benefits that can only be attained by looking at something over a period of time.

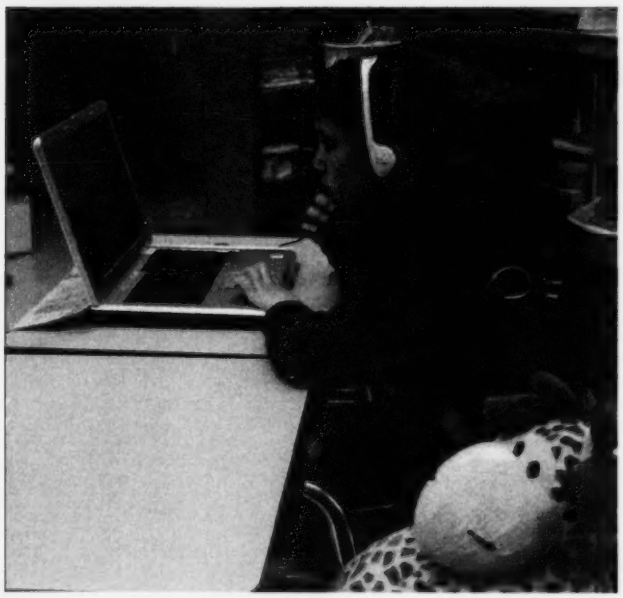
points. Paired *t*-tests were employed to determine if a statistically significant difference between Time 1 and Time 2 existed.[3]

Table 8. : Total SLI respondents by time

	Fall 07	Fall 08	Spring 09	Fall 09	Spring 10
Total *N*	1462	319	1408	429	1438
Longitudinal *n*	475	294	435	338	672

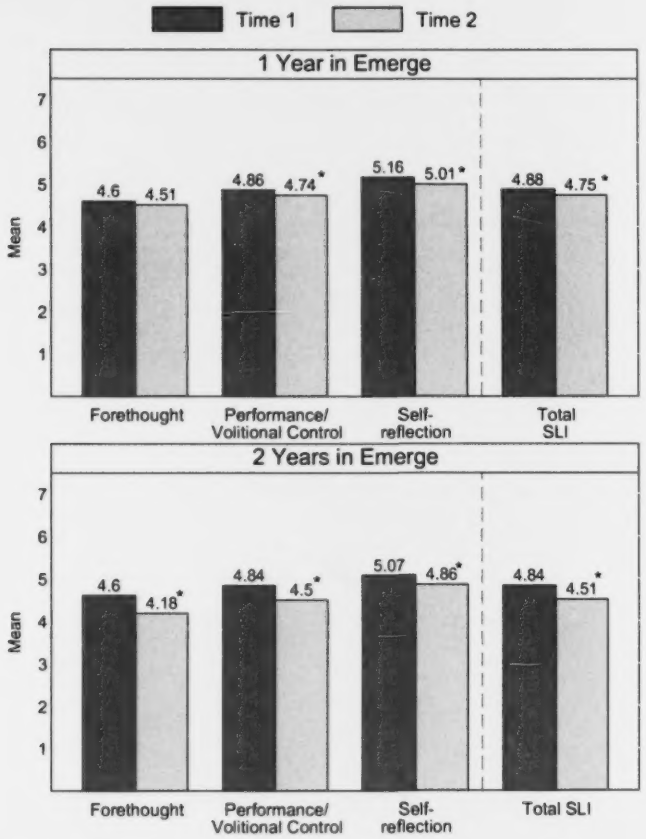
Major Findings: Longitudinal student self-direction

Mean scores for the three main SLI Scales and the Total SLI score at Time 1 and Time 2 are presented below. As shown in Figure 21, the longitudinal sample of students in Emerge for *1 Year* had statistically significantly lower mean scores on the scales of *Performance/Volitional Control* and *Self-reflection* at Time 2.



[3] Statistical significance indicates whether data is worth paying attention to, rather than a statistical fluke. The term "significant" is not intended to indicate a judgment about the degree or the educational relevance of the differences. Rather it is intended to identify statistically dependable population differences in order to help inform dialogue.

Figure 21. Mean scores on the SLI subscales and Total SLI scale by number of years in Emerge, across years



NOTE: Aggregate.

NOTE: * statistically significant at p <. 05. 1 Year [in Emerge] *N*=773; 2 Years *N*=334.

Discussion

Why did self-direction levels decrease or remain the same across years?

There are several reasons why the levels of reported self-direction may have decreased across years. Teachers may have not had adequate training, support, or instructional time to introduce and emphasize the strategies associated with self-directed learning, given the multiple goals for the Emerge project. Or it could be that changes in students' self-directed learning behaviors require a longer period of time to emerge.

Additionally, research suggests that academic motivation declines throughout the elementary years, with the decline seeming to accelerate with the transition to middle school (Anderman & Midgley, 1999; Eccles et al., 1993; Lumsden, 1994). This may have been a possible reason for the scores to decrease, since a high percentage of students moved from elementary to secondary during the program's duration.

Limitations

There are several limitations to these findings. First, all the student components were measured with a self-report instrument. Further, tracking by cohort has certain limitations, including the following:

- *Attrition.* As in any longitudinal matched analysis, attrition may have occurred.

- Some students' earliest available data point is in the Spring, rather than Fall semester. This creates a quandary because these students most likely did not take the survey when they entered the program. Therefore, although several students have a Time 2 and Time 3 score, without a true Time 1 score these students were excluded from the longitudinal analysis.

- *Survey fatigue.* Since student respondents had already been surveyed before, there was a concern that non-response (answering only a small portion of the survey) or nonparticipation (not taking the survey at all) could be sizeable–and it was.

- *Vast differences in implementation fidelity.* Throughout the three-year project, the dissimilarities in the organization and implementation of Emerge among the jurisdictions became increasingly evident. The Jurisdictions differed in content focus, inclusion of special student populations, and length of participation of students and teachers across the three years. Some schools established programs in which the laptops were assigned to specific grades, which resulted in the same teachers, but different students, using them each year. Others decided that the laptops would follow the students (as long as the students remained in the Emerge school), which meant that the same students, but often, different teachers, were assigned the laptops in the second and third years of the program. Furthermore, some jurisdictions permitted students to take their laptops home, while others did not.

Readiness of students to thrive in a complex, global, high tech society

Discussion

21st Century Learning is defined here as learning that embodies the effective use of emergent research on how people best learn; contemporary technologies; and one or more 21st Century Skills. For this section, we concentrate on predominately site visit data gathered through classroom observations and interviews with staff, students, and parents. Site visits were conducted annually in each of the 20 participating jurisdictions in Spring 2008, Spring 2009, and Spring 2010 by a member of the evaluation team.

Finding 1.5

Overall, Emerge students significantly increased their readiness to thrive in a complex, global, high tech society. They increased their levels of expertise with 21st Century Skills, and their teachers increased the frequency at which technology was used to engage students in deep, complex, authentic and relevant learning activities.

This represents a strong beginning for the provincial advancement of 21st Century Learning.

In identifying 21st Century Learning in Emerge schools, the research team looked for the following indicators:

1. 21st Century Skills focus
2. Instructional style conducive to 21st Century Learning
3. Mid to high levels of complexity
4. Authentic learning focus
5. Effective uses of contemporary technologies

The research team triangulated data from several sources in support of this finding. First, analysis was done of the survey data from teachers and administrators, the site visits, and the information from the points-of-contact and other educators at the Emerge events. The quantitative data indicate that schools have made progress with 21st Century Skills and in shifting instructional approaches from didactic toward coaching and constructivist, which are more conducive to 21st Century Learning. The data from the classroom observations and other aspects of the site visits support these findings.

21st Century Skills

21st Century Skills are those skills beyond the academics deemed to be critical to today's students. At the inception of the program, the 20 Emerge jurisdictions used various lists and definitions of 21st Century Learning including the enGauge 21st Century Skills from Metiri Group and the North Central Regional Educational Laboratory (Figure 8) and the U.S.-based Partnership for 21st Century Learning.

Each of the Emerge jurisdictions set individual goals and objectives for their program, thus each jurisdiction addressed different combinations of 21st Century Skills. The point-of-contact in each jurisdiction indicated their jurisdiction's success in advancing the following 21st Century Skills, as noted in Table 9.

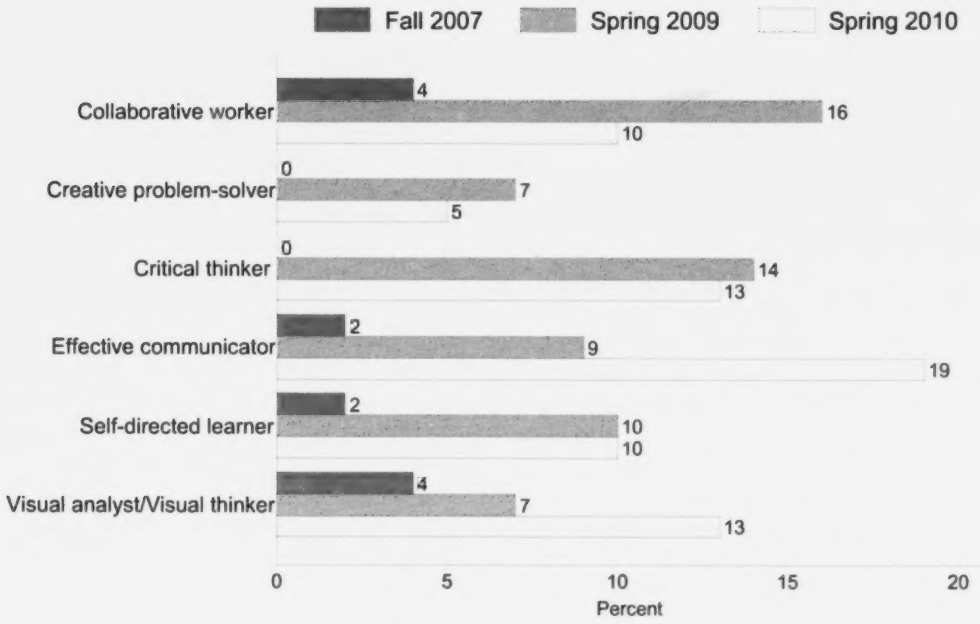
Table 9: Average Project Lead rating of how successful they believe Emerge has been in accomplishing various goals (on a 1-8 scale with 8 being very successful and 1 being not at all successful)

	Score
Increase the ICT (information and communication technology literacy) of students	7.4
Increase the collaborative learning between students locally, through effective uses of the laptops and other technologies	6.8
Increase critical thinking among students through effective uses of the laptops and other technologies	6.4
Increase global awareness of students through effective uses of the laptops and other technologies	6.0
Increase collaborative learning between students online	5.9

SOURCE: Spring 2010 project lead survey. *N*=18 (2 non-respondents of the 20 jurisdictions).

Whereas in the first year of Emerge, the site reviewers reported few instances where teachers were addressing 21st Century Learning, by the end of Years 2 and 3, the site reviewers were beginning to see increasing instances in classrooms where "substantial evidence" of 21st Century Skill development was underway. In Spring 2010, the site reviewers visited 56 classrooms in 20 jurisdictions, noting substantial evidence of *Effective Communication, Visual Analysis and Visual Thinking, and Critical Thinking* in 19%, 13%, and 13% of classrooms respectively. See Figure 22.

Figure 22. Percentage of classrooms across time periods where "substantial evidence" was observed for each skill



Fall 207. N=59 classrooms. Spring 2009. N=57 classrooms. Spring 2010. N=56 classrooms.

The variations in trends represented in Figure 22 suggest the emphases on 21st Century Skills shifts from teacher to teacher and year to year. The increased emphasis on *Effective Communicator* and *Visual Analyst/Visual Thinker* suggests that students are increasingly asked to demonstrate what they learn through the creation and production of digital products. Again, anecdotes demonstrate the powerful learning within some Emerge classrooms.

Science, Intellectual Complexity and Collaboration

Their learning goal was to build, program, and test a robot that would meet given specifications, while working collaboratively with other student groups. In this science classroom, a Lego Mind storms Robotic kit was given to each table group of students. The teacher informed the students that in their table groups, the following three jobs would need to be completed: planning, construction and programming and videoing. Students in their groups volunteered for one of the jobs. Throughout the class, the students were engaged in learning and worked collaboratively in their roles as they were constructing and testing their particular robot. At the end of the class, the students who volunteered to video the work used a movie software to capture what had occurred with regard to construction, problems, and the current stage of development of the robot. This information was then posted online so the next group of students who were assigned that table (e.g., the particular robot) could view the video and continue the work where it was left by the last group of students.

With three groups/classes of science students using the same robotics kits a number of 21st century skills were demonstrated in this unit of study (e.g., creativity, innovation, critical thinking, problem solving, communication, and collaboration). Collaboration was a key component in this work. Not only was it important for the work of students within their table groups, but also it was key among three science classes where each class was responsible for sharing the current state of construction with the next group so they could continue the building process.

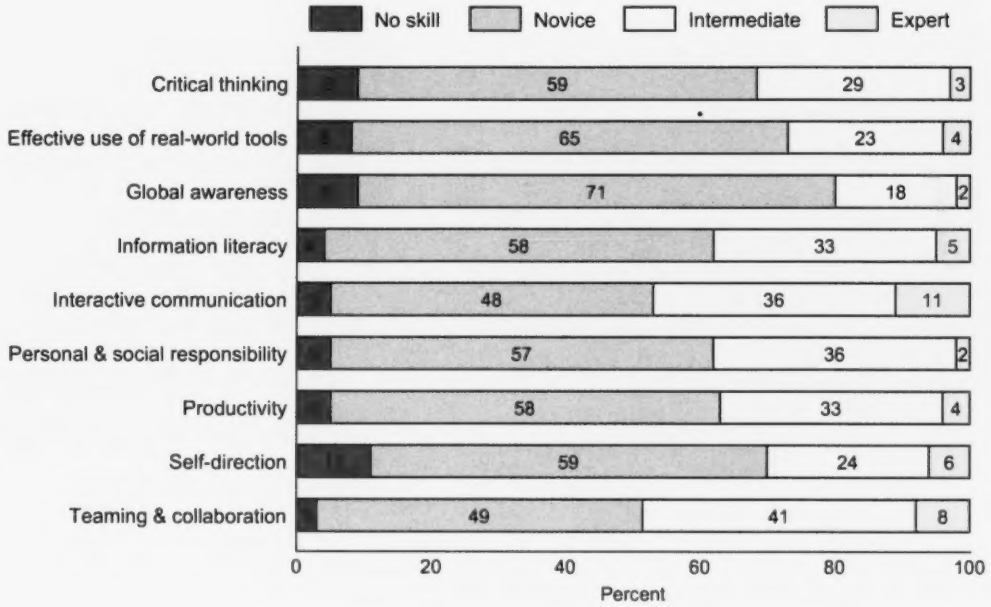
Digital Representation of Student Understanding

In one Emerge classroom, as a part of the Grade 6 Science quiz, students were required to show and label the phases of the moon. Each student selected an application of choice to present his/her understanding of this topic. Some students selected such software as Keynote, Notebook or Kid Pix for the quiz. Using the selected application, they drew and labeled, using textboxes, the phases of the moon. Through this activity, students not only demonstrated their ability to present a visual representation of their understanding of the phases of the moon, but also their ability to effectively use a computer application to represent their knowledge.

While much progress was made by the Emerge jurisdictions, much is left yet to accomplish in student attainment of 21st Century Skills even with students involved in a project such as Emerge. Figure 23 represents the range of Emerge student expertise as reported by teachers in Spring

2010, the third year of the Emerge project. As indicated, the majority of students in Emerge are still in the Novice category.

Figure 23: Percentage of teachers indicating respective rating of student expertise for skills in Spring 2010



Fall 2007. N=59 classrooms. Spring 2009. N=57 classrooms. Spring 2010. N=56 classrooms.

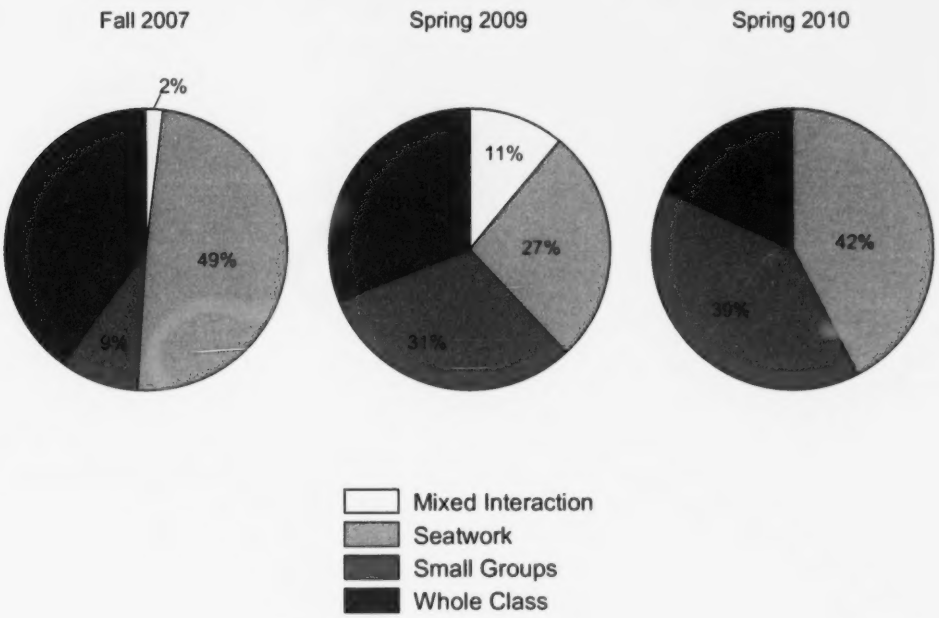
While the Emerge classrooms are addressing some of the 21st Century Skills, there is much variance across classrooms. This represents a strong beginning for the provincial advancement of 21st Century Learning.

Student Groupings

The "student groupings" describe how students are grouped during classroom lessons. The researchers consider this important because certain types of groupings are strong indicators of instructional style. For example, large percentages of whole-group instruction suggest an orientation to didactic teaching, whereas small groups indicate the potential for collaborative student work. The researchers take a read of the groupings three times during each classroom observation and would expect to see a variety of groupings across multiple classroom observations within a school, a jurisdiction, and the province.

From Fall 2007 to Spring 2010, the percentage of students in the various types of student groupings within classrooms shifted significantly. In elementary classrooms (Grades 3-5), whole class instruction decreased from 40% to 18%, and seatwork decreased from 49% to 42%. Meanwhile, small group work increased from 9% to 26% as shown in Figure 24.

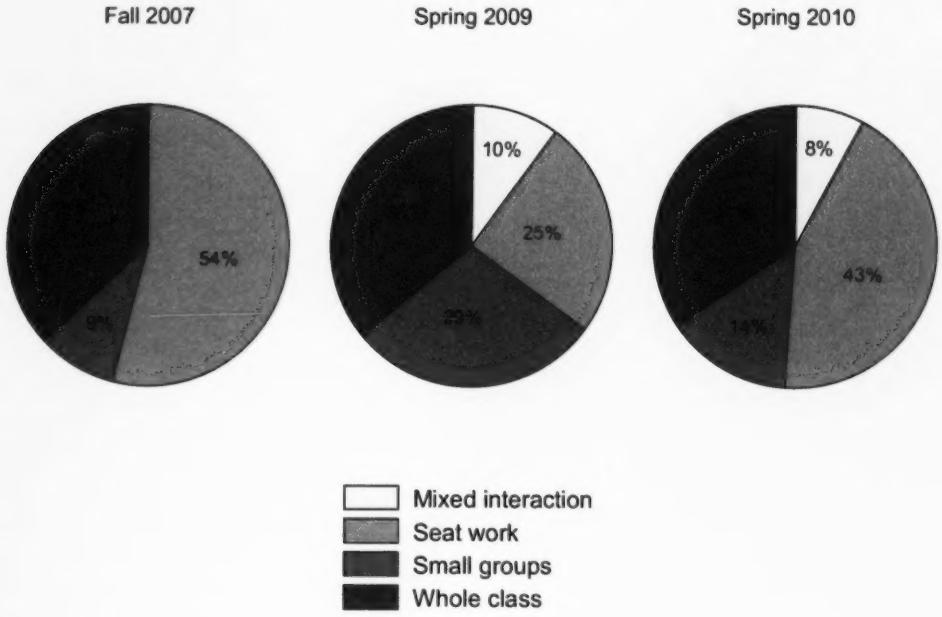
Figure 24. Classroom organization: Mean percent of time for Grade 3-5 student groupings



SOURCE: *Site observations. Fall 2007: n=34; Spring 2009: n=32; Spring 2010: n=12.*

In secondary classrooms (Grade 6-12), as shown in Figure 25, from Fall 2007 to Spring 2010, whole class instruction slightly decreased from 37% to 34%, and seatwork decreased, from 54% to 43%, after having been down to 25% in Spring 2009. Small group work increased from 9% to 14%, after having been up to 29% in Spring 2009. While the changes from Fall 2007 to Spring 2009 enabled increased opportunities for collaboration among students, they did slide back considerably in 2010 to include a significant percentage of seatwork.

Figure 25: Classroom organization: Mean percent of time for Grade 6-12 student groupings



SOURCE: *Site observations. Fall 2007: n=25; Spring 2009: n=25; Spring 2010: n=22.*

In summary, students in observed classrooms (all grades) in Fall 2007 were spending approximately a third of their time in whole class instruction, about half of their time in seatwork (some of which included interaction), and the remaining time (one-sixth of their time) in small groups. That changed in the Spring 2009, with students in observed classrooms spending only a quarter of their time in seatwork, and nearly a third in small groups. While this trend held for elementary classrooms in Spring 2010, it reverted back to the baseline levels for secondary classrooms by Spring 2010.

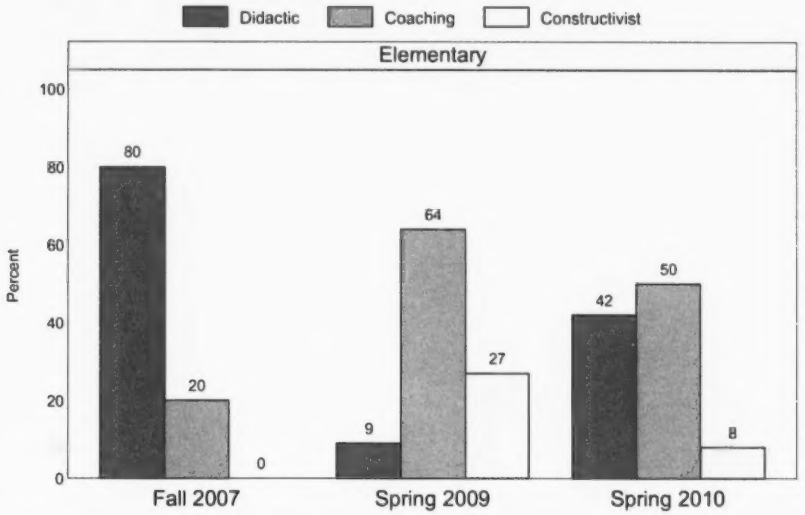
Instructional Strategies

One of the goals of most of the jurisdictions in the Emerge program is more student-centered learning. To accomplish this, instructional strategies need to include a measure of coaching and constructivist instructional approaches to learning. The researchers take a read of the instruction in each classroom at three points in time, recording the degree to which the instruction is didactic (e.g., whole class lecture or discussion), coaching (e.g., scaffolding student learning individually with students or in small groups), or constructivist (e.g., inquiry or problem-based learning).

There was a positive shift toward a more balanced combination of instructional styles in all classrooms from Fall 2007 to Spring 2010. In Fall 2007, the observations revealed the most common instructional approaches to be didactic, with some degree of coaching evident for both elementary and secondary, but no constructivist learning. The classroom observations in Spring 2009 revealed dramatic shifts in practice toward greater emphases on coaching, with some constructivism beginning to emerge in both elementary and secondary levels. By Spring 2010, the

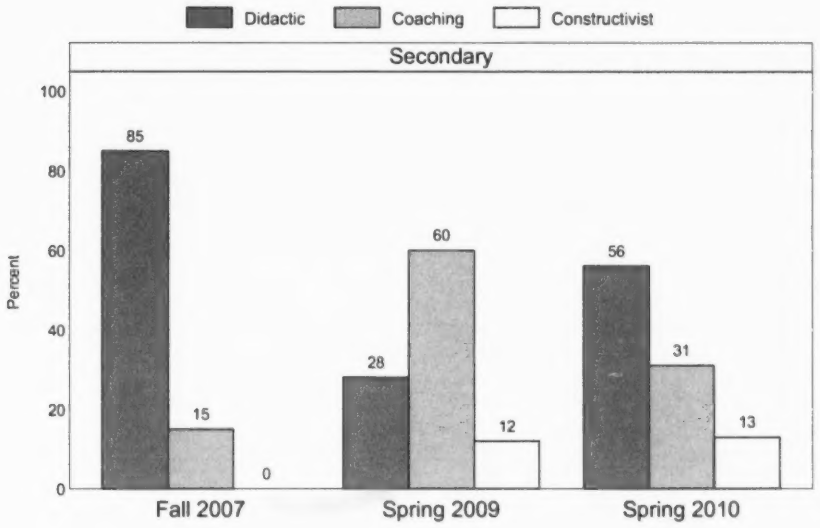
balance had shifted again. At the elementary levels the balance was now 42% didactic, 50% coaching, and 8% constructivist.

Figure 26. Trends in observed types of instruction in elementary schools



SOURCE: *Site observations. Fall 2007: n=34; Spring 2009: n=32; Spring 2010: n=34.*

Figure 27: Trends in observed types of instruction in secondary schools



SOURCE: *Site observations. Fall 2007: n=25; Spring 2009: n=25; Spring 2010: n=12.*

There were also significant shifts in types of instruction at the secondary level from the baseline in Fall 2007 to Spring 2010. While secondary classrooms significantly reduced didactic teaching

from 85% in Fall 2007 to 28% in Spring 2009, that pattern reverted back to 56% didactic by Spring of 2010. However, the constructivist teaching increased from 0% in Fall 2007 to 12% and 13% respectively in Spring 2009 and Spring 2010.

At the end of the Emerge project, elementary schools had less didactic teaching and more coaching than did secondary. However, the secondary schools had slightly more constructivist learning than did the elementary classrooms.

Designing and Developing to Demonstrate Learning

Three teachers in one school collaboratively planned and implemented a project where Grade 6 students worked in teams to create digital newspapers. Each team was composed of five students from the three classes. As a newspaper team, they designed the structure of it, wrote the various items, and compiled their online newspaper. Using instant messaging, they planned the paper so that students in the three classes could virtually work together without having to be in the same physical location. Each student assumed a role and the responsibility of that role for the work (e.g., reporter, assistant editor, editor, advertising director, and columnist).

Various types of technology were used during this collaborative newspaper project. For example, interviews were captured using iPod Touch and Audacity. Students also video recorded individuals who spoke about their experience with the Emerge one-to-one project. The video was then embedded in their online newspaper. Another example of technology use was the use of a PowerPoint weather report. A third example was when the editors used instant messaging or email to communicate with their writing team (e.g., follow up on the submission of articles and edited work).

Students were engaged in an authentic collaborative task. Through the work, they demonstrated their understanding of different types of writing and the various components featured in their newspapers (e.g., editorial, feature articles, news stories, cartoons and advertisements). Further, they purposefully selected and used technology to design and develop their digital newspapers.

Authenticity of Student Learning and Complexity of Student Thinking

As the teachers became more expert in the use of technology they were able to step back and assess the depth of student learning and the quality of student product accomplished within the Emerge program. What they noticed was that, when students were presented with essential questions that were open-ended without a "right answer," it caused students to think more deeply about an issue, resulting in their "owning" the issue, developing a position, and using evidence to defend that position. In the classrooms that focused on inquiry, the resultant critical and critical thinking gains were profound, and the products students used to demonstrate their learning were often of high quality.

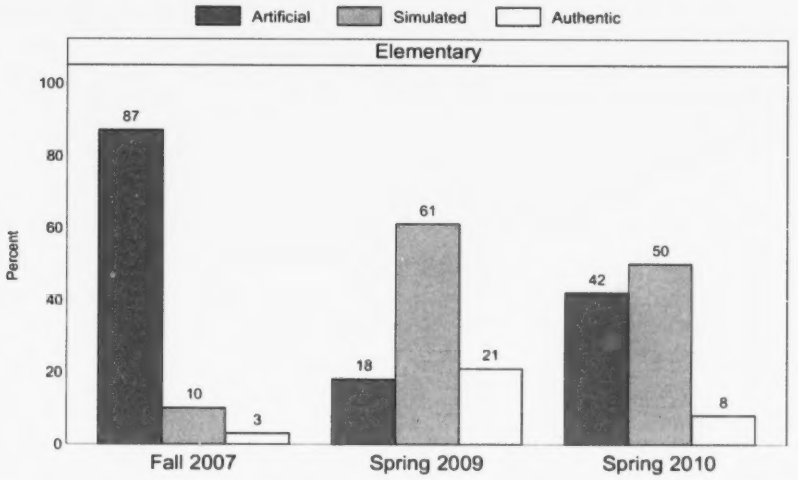
Authentic Learning

According to experts such as Dr. Fred Neumann (1992), former professor at the University of Wisconsin, Madison, authentic learning includes three critical elements: deep inquiry of the

content under study; relevancy of the student work to persons or entities beyond the school day; and students' demonstration of their learning through products. Due to the strong correlation between student engagement, learning with understanding, and academic achievement, the researchers documented the extent to which they observed authentic learning in Emerge classrooms. A low score in authentic learning was designated as Artificial (lacking real-world application), a mid-range score was designated as Simulated (imitating real world), and a high score noted as Authentic (modeling real-world applications).

At the Baseline in fall 2007, few classrooms were exhibiting authentic learning – 3% of elementary classrooms observed and 0% of secondary classrooms observed. By Spring 2009 the researchers did note higher number of instances of authentic learning in observed classrooms at both elementary (21% authentic) and secondary (16% authentic) levels. (See Figure 28 and Figure 29.) That shift paralleled a shift in pedagogy in Spring 2009 that demonstrated teachers were increasingly moving their instructional strategies toward constructivism. However, by Spring 2010 that momentum in elementary classrooms toward more authentic learning has subsided, decreasing and then holding steady at 8%, an overall increase of 5% over the two years.

Figure 28. Observed authenticity in elementary classrooms



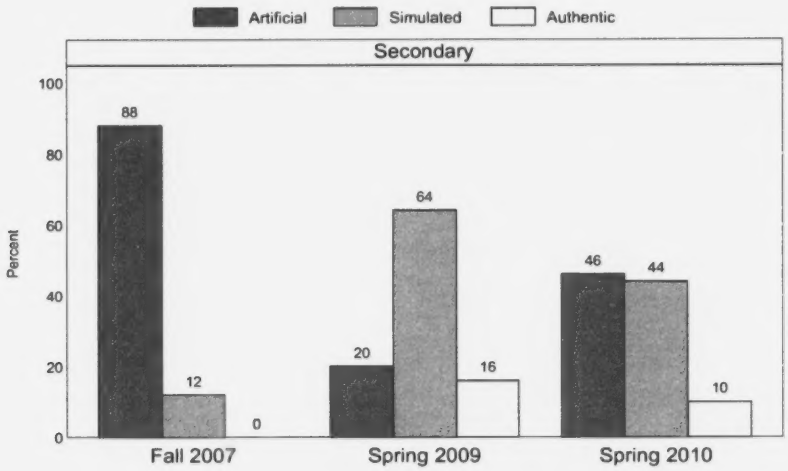
SOURCE: *Site observations. Fall 2007: n=34; Spring 2009: n=32; Spring 2010: n=12.*

On a parallel track, secondary classrooms made substantial shifts over the three years of the project away from artificial learning toward simulated and authentic learning. Secondary Emerge classrooms shifted substantially toward authentic learning in the first year of the project, moving from literally 0% authentic learning in the fall of 2007 to 16% in Spring 2009, with a slight decrease to 10% in Spring 2010. In general the shift from mostly Artificial (88%) lessons in Fall 2007 to a more balanced approach in Spring 2009 and Spring 2010 held for secondary classrooms.

Learning from Their Own Data

As part of the Grade 6 forensic science unit, students were learning about fingerprinting. Students examined their own fingerprints using a magnifying glass. Within their groups, they learned about each others' fingerprints for the purpose of looking for patterns. Common patterns were drawn on the whiteboard. As a class, they found out what was the most common type of fingerprint in their class and then searched the Internet to learn more about patterns. Further, one student did a tally on the board of the types of thumbprints found in their classroom. Each student used Excel to create a graph based on the tally of thumbprint types. The authenticity of this learning opportunity allowed students to learn about fingerprints by using their own data. The technology allowed them to access information and to analyze and visually present data.

Figure 29. Observed authenticity at the secondary level



SOURCE: *Site observations. Fall 2007: n=25; Spring 2009: n=25; Spring 2010: n=44.*

From the site visit data, it was evident that learning is being designed where students have a voice and are actively involved in creating and co-creating knowledge.

Sharing Their Voice with Others

Through the use of a collaborative blog, Grade 5 and 6 students have been examining and exploring global issues with connections in their own backyard. The blog has provided an opportunity for students to share information with a group of students from Minnesota. They have been using various sources of information (e.g., articles from current newspapers and guest speaker) to inform their understandings. They have been sharing their research and reflections with regard to real-world issues. By posting on the blog, students' work is public and an audience beyond their classroom is able to read and respond.

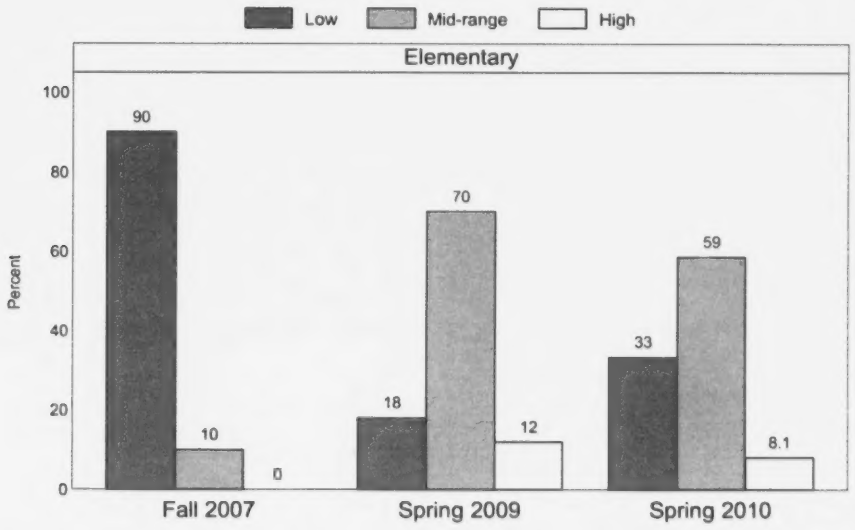
Students in Emerge classrooms appear to be more engaged in higher order thinking, with a greater focus on deep knowledge, and in making connection to the world beyond the classroom. More sophisticated use of technology is being used to support real world tasks and fostering deep learning. Connections are being made to students' personal lives and connecting to others.

Level of Complexity

Low levels of complexity map to lower order thinking skills and development of basic skills, whereas high levels of complexity represent higher order thinking skills/learning. The researchers took a read of the level of complexity of the lessons three times in each classroom observation. They recorded the complexity as low, mid-range, or high, taking into account the grade level of the students.

As shown in Figure 30, the level of complexity observed in the elementary Emerge classrooms increased significantly from Fall 2007 to Spring 2009. In Fall 2007, nearly all observed instruction were characterized by low levels of intellectual complexity. That shifted in Spring 2009, with 70% of elementary classrooms classified in the mid-range level of complexity, and 12% classified as high intellectual complexity. By Spring 2010, that had leveled off at 33% low, 59% mid-range and 8% high, but still represents a major shift toward high complexity from baseline.

Figure 30. Observed levels of complexity by time at the elementary level

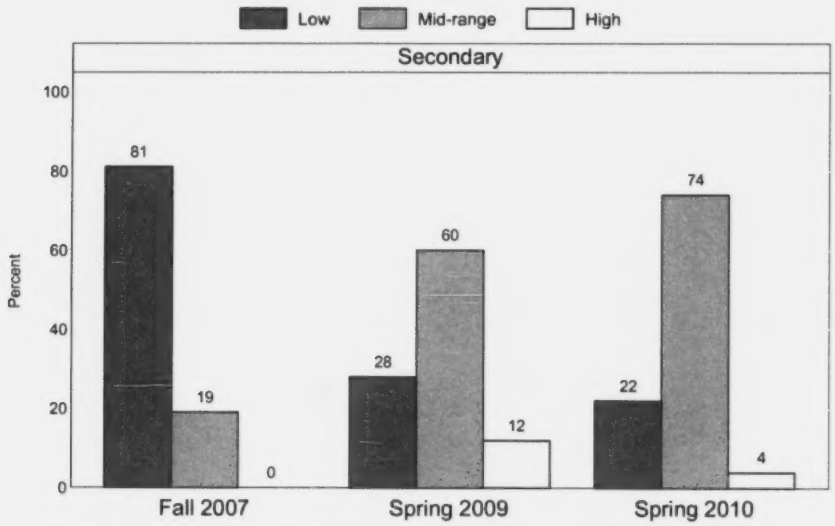


SOURCE: *Site observations. Fall 2007: n=34; Spring 2009: n=32; Spring 2010: n=12.*

The trends in secondary classrooms also indicate significant shifts higher complexity. While most secondary classrooms did not achieve the high range of complexity they did make significant shifts into the mid-range, moving from 19% in mid-range in Fall 2007 to 60% in Spring 2009,

and up to 74% mid-range in Spring 2010. The secondary classrooms were at 0% for high intellectual complexity in Fall 2007, increased to 12% in Spring 2009, but then dropped back to 4% in Spring 2010.

Figure 31: Observed levels of complexity by time at the secondary level



SOURCE: *Site observations. Fall 2007: n=25; Spring 2009: n=25; Spring 2010: n=44.*

Classrooms at both the elementary and secondary levels made significant gains in complexity of learning from Fall 2007 to Spring 2009. While the secondary schools did not totally maintain the gains they made from Fall 2007 to Spring 2009, overall the complexity has increased since the baseline in Fall 2007.

The anecdotes below provide some insights into Emerge classrooms with high-quality 21st Century Learning. The following descriptions of classroom activities represent several approaches where Emerge teachers have increased the complexity and richness of student learning.

Asking Essential Questions

In a fifth grade classroom, children used Skype (a free method of video conferencing using their laptops) with an Art Museum curator, discussing a range of artists' works in different media. In a subsequent lesson, student groups were asked to choose a work of art from the museum and develop an essential, open-ended question that would serve as a lens through which to explore the artwork. The teacher scaffolded the activity by providing students with a self-assessment checklist for essential questions, asking if the question was: on topic, open-ended, engaging, and respectful. Each group of students generated three essential questions for their piece of art, used the checklist to analyze the quality of each of their questions, and then chose the best essential question to guide their investigation of the artwork. From there they used a search engine to research their question, developed answers to their respective questions, and videotaped themselves answering the questions using the evidence they collected.

The use of essential questions provides important frames for inquiry learning. If developed as open-ended, deep questions, essential questions can capture students' imaginations, developing intrinsic motivation to dig deeply into a subject. The open-ended aspect causes students to consider researched facts, not as ends to their research, but rather as evidence they might consider as they use higher order thinking strategies to compare, contrast, and evaluate the data.

The following classroom example from Emerge provides a second example of how teachers are engaging students in argumentation that increases their critical and creative thinking, communication skills, research skills, and collaboration skills. The complexity of learning and the authenticity of learning increase tremendously due to the public debate forum and virtual linkages between schools.

Evidence-based Argumentation

Grade 6 students from two schools participated in a horseshoe debate using Communicator. The issue they debated was that of the city council imposing a midnight curfew on youth. In preparation for the debate, students conducted research and prepared a written response defending their position on the issue. In their written work, they had to choose a position, provide reasons for their choice along with examples to support their position, and provide a concluding statement.

On the day of the debate, one teacher facilitated the session and began it by reviewing the debating process with the two groups of students. In the debate, students from each school took turns presenting their arguments. This was followed by an open mike session where a number of students participated in the debate by responding to statements being made by their peers from the other location. At the end of the debate, students reflected on the information presented and were asked to determine if their position had changed. If their position had changed, students then moved within their horseshoe to reflect to what degree it had changed (e.g., moved one or two seats or moved to the other side of the horseshoe). The class ended with a debriefing of the session.

The debate provided an opportunity for students to present their arguments and respond to statements made by colleagues as they explored various facets of the topic. Students were engaged in debating the topic given it was relevant to them and one where they could articulate their position on the issues with their peers. Further, through the use of technology, students had the opportunity to engage in debate with peers from another school without having to travel to the school.

In summary, the significant shifts in classroom practices suggest that many of the Emerge teachers are changing their classroom practices to leverage 21st Century Learning through the laptops.

Question 2: Technical Merits and Innovative Practices

Research question: What are the technical merits and innovative practices in one-to-one wireless learning?

> *A robust infrastructure and just-in-time tech support are essential elements to launching a one-to-one project. Digital tools cannot be used for online collaboration and video-based work without such an infrastructure.*
> *- Emerge Project Lead*

The Emerge jurisdictions spent the first year focused on purchasing and deploying laptops and wireless networks in their schools. By the end of the first year, those networks were established and their attention turned to technical support, maintenance, and expanding the access. This focus on expanding access in Years 2 and 3 was due in part to the pressure from students, teachers, and parents. In the cases where the laptops followed the students, teachers who were in classrooms with laptops had adapted their teaching to incorporate technology and wanted to continue the use of the technology with the incoming classes. In the case where the laptops stayed at one grade level, there was pressure from students and their parents to expand the program so those students could continue the use of these technologies into subsequent grades.

Finding 2.1

In many schools, the Emerge program was expanded to other grades as early as the second year of the program to accommodate use by teachers who had shifted classroom practices to incorporate technology and wanted to continue, and to ensure that students with one year of laptop learning could continue in subsequent years.

Wireless networks

Wireless networks have been established by the Emerge programs that are, in general, adequately meeting the requirements of most Emerge one-to-one programs. The first year of the Emerge program was largely focused on the purchase and deployment of wireless networks, laptops, and associated peripherals. The Emerge project enabled the jurisdictions to establish well-resourced pilots within the district to test the use of wireless networks. As a result network stability and wireless upgrades have also increased over the three years, both in the Emerge project and beyond.

Finding 2.2

Wireless networks established by the Emerge programs provided a well-resourced pilot for wireless networks that informed future jurisdictional plans and investments.

What HAVEN'T we learned about wireless networks and hardware set-up as a direct result of the Emerge project? When we began the project we were groping in the dark, using trial and error in an attempt to arrive at the best solution for wireless. The Emerge funding gave us the flexibility to invest in solid infrastructure, which has already been expanded since year one, and also invest in a variety of tools to monitor and deploy wireless in our schools. We've gone from 4 wireless sites to over 100 and the expertise of technical staff at all levels has increased just as exponentially.

- Emerge Project Lead

Technical support

Finding 2.3

The level of technical support to launch a project such as Emerge is fairly intense, but decreases somewhat over time as teachers become more familiar with the technologies and as the stability and reliability of the network increases.

Some jurisdictions have dedicated staff assigned to the program, whereas other jurisdictions have incorporated the Emerge support into their overall district support. Within the Emerge program, the learning process is highly dependent on student access of high-speed bandwidth and operational laptops.

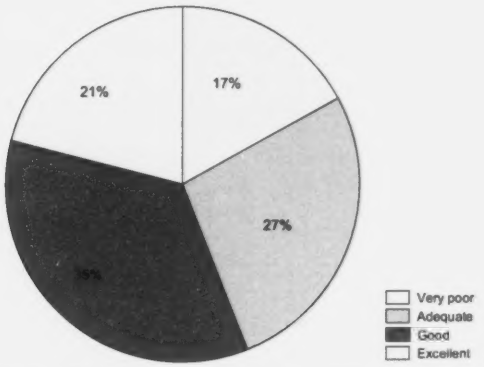
When technical problems arise that are queued within the district's technical support system, rather than attended to as priorities, the learning program is disrupted. This issue prompted discussion among participants as to the importance of flexibility and adaptability on the part of the teacher and students, and, on the flip side, the importance of a service orientation on the part of the technical support staff. Some of the optimal models for technical support were grounded in strong relationships between school staff and those personnel providing the technical support, as well as accessibility. When the ratio of technical support to classrooms and equipment is too high, programs and learning suffer. The jurisdictions also noted how important it was to teach students and novice staff about the basic care and handling of the equipment to avoid damage.

Finding 2.4

The one-to-one access by students to technology devices has been a central focus of the Emerge program. The take-home policy for the devices varies by jurisdiction, often in response to variations across communities.

Now, in the third year of the program the feedback from teachers indicates that the level of technical support varies across the jurisdictions. Seventeen percent of administrators still, at this point in the program, rate it is a barrier to success (see Figure 32).

Figure 32: Percent of administrators indicating that the Emerge program has technical support with little or no wait-time.



SOURCE: *Administrator Surveys, Spring 2010, n=116*

Technical support of 1:1 devices can require more time and increased knowledge from the technician's perspective. As teachers became more comfortable in using the laptops, they gained basic troubleshooting skills, which meant less tech support. Network stability and wireless upgrades have also increased over the three years, which has decreased the amount of school tech support required.
- Emerge Project Lead

Access

A basic tenet of the Emerge project is one-to-one laptop learning, but the models vary across jurisdictions. Some schools have laptops on carts, while others check out individual devices to students.

Take home policies also vary. In most Emerge schools the students use the devices both in school and at home on a daily basis. In others, where homes may not have Internet access, or where there are other risk factors, use is limited to in-school activity or take home policies are more ad hoc. The Emerge Project Leads noted that, "*Despite the lack of access in the homes, schools can effectively use technology as a learning tool.*" Some jurisdictional leads noted that daily transporting of laptops from home to school and back "*reduced the life of the laptops*."

Beyond the laptops, administrators say that other technologies are available in their schools for use by Emerge teachers. For example 85% of Emerge administrators say that digital whiteboards are available, 83% say cameras are available, and 47% say response devices (clickers) are available. However, when asked about the adequacy of the variety of equipment (e.g., cameras, scanners, etc.) Emerge teachers want to use with students, 28% of administrators reported the adequacy as excellent, 40% rated it good, 25% rated it adequate, and 8% rated it as poor. When asked about the reliability of their schools' computers, printers, projectors and other equipment, 62% rated it as excellent or good, 21% rated it as adequate, and 11% rated it as very poor.

Finding 2.5

The reliability of Emerge schools' access to the Internet was rated as excellent or good according to 69% of teachers and 74% of administrators.

Other important aspects of access are the speed reliability of the local area networks and the access to the Internet. Sixty-nine percent of teachers said the Internet connection was fast and reliable, while 31% said that was not true for their schools. Administrators reported similar statistics when asked whether their schools had reliable, high-speed access to the Internet in classrooms, labs, and media centers: 74% rated such access as excellent or good, with the remaining 26% rating it as adequate.

One of the areas that has surfaced among Emerge educators is the access to an online environment that supports student and teacher use of blogs and wikis. Nearly 50% of administrators said that access for Emerge teachers and students was excellent or good, with 37% rating it as adequate, and 13% rating it as poor.

Use of Software/Applications
Students have developed a greater awareness of various software/applications and the capacity to make decisions of where and when to use these items in support of their learning. For example, in a junior high school science class, one student selected to use Paint to a draw a diagram because he could not find a picture on the Internet that was appropriate for the assignment. Using this drawing program, the student created the diagram and labeled it using textboxes. A second example was in a junior high school English Language Arts class where in completing their work used various applications (e.g., MS Word, MS PowerPoint, and MS Photo Story) in presenting and/or representing their knowledge and understandings.

Online Collaborative Learning
Teachers and Grade 11 and 12 students were involved in a collaborative project where technology bridged discipline areas, grade levels and physical distance between two Alberta schools. Teachers in a rural high school and an urban high school from two school jurisdictions designed, developed and facilitated an integrated unit of study on the Holocaust. A Moodle discussion forum was created for each group that included students from Social Studies 20 and English 30. Within their discussion forum groups, Social Studies 20 students shared factual information about the Holocaust based on what they had been learning. English 30 students had read Ely Wiesel's personal story of his time spent in a concentration camp. The English 30 students posted a reply using information from their Social Studies colleagues and added to the discussion with information about how Ely Wiesel was affected. This collaborative project provided students the opportunity to learn *from* and *with* each other through the use of asynchronous communication technology.

Sustainability

As educators in Alberta close out this chapter on the Emerge program, they are reflecting back on the past three years to identify lessons learned in order to sustain the critical components of Emerge, and to inform future planning and investment. Some of the issues that have arisen are: student-owned devices, finding issues related to sustainability and scaling up, policies related to one-to-one laptop learning, and professional development. Those issues are further discussed in the next section in this document.

Question 3: Expertise, Experience, and Lessons Learned from Emerge

Research question: What expertise, experience, and lessons learned have come from the Emerge One-to-One Laptop Learning Project in Alberta?

> *I believe that the Emerge program has done more to positively impact instructional practices than most other initiatives. It has lent itself to job embedded professional development and our teachers have really increased their collaborative efforts and practices. They are using much more in the way of project based learning than ever before. Assessment practices have improved, and teachers are doing much less photocopying and much more facilitating of learning rather that the old stand and deliver approach.*
>
> *-Emerge Principal*

The Emerge program represented a steep learning curve for many students, teachers, and administrators, on three fronts: the technological, the organizational, and the pedagogical. The first year of the program was focused on the purchase and deployment of technology; building and scaffolding the technical knowledge and expertise of teachers and students; and establishing new classroom management procedures and, to some degree, new instructional approaches to facilitate learning.

An added degree of complexity was introduced by some jurisdictions' decisions to have the laptops follow the students from grade to grade, resulting, in most cases, in different teachers teaching the students in Year 2 of the program. In other cases Emerge teachers stayed with the program—i.e., they moved to the next grade with their students, or the laptops stayed at their grade level and did not stay with the students. These teachers had acquired some expertise, and technological knowledge and skills, and were now concentrating on the new designs for learning enabled through technology. Other teachers were new to the program, and now at the beginning stages of the technological learning curve, and were teaching students often more experienced technologically than they were.

As a result, Emerge teachers and students are at different levels, yet making steady progress in developing the fluency, expertise, and knowledge base necessary to use the technology to advance learning.

> *Teachers have risen to the challenge and are exploring new practices and strategies for 21st century learners.*
>
> *- Emerge Principal*

The following findings represent the status at the end of the three-year project. The recommendations are presented by the researchers for consideration by Alberta Education and the Alberta jurisdictions.

Educator fluency

Educator fluency with technology precedes innovative and effective use.

The Emerge educators (teachers and administrators) have made steady progress in their proficiency with technology and 21st Century Learning. There seems to be a natural progression in such learning that necessitates the teachers' acquisition of technology fluency prior to effective uses for learning.

Finding 3.1

The Emerge educators (teachers and administrators) have made steady progress in their proficiency with technology and 21st Century Learning. That expertise is translating into creativity and innovation in instructional practices in the classroom that better utilize technologies for learning, especially for those educators who were involved in Emerge for multiple years.

Professional development expert, Thomas Guskey (2002), reports that three general outcomes for professional development are changes in teachers' beliefs and attitudes, changes in teachers' classroom practices, and changes in student learning outcomes. The order he finds in which they occur is surprising: first changes in practices, followed by changes in student learning outcomes, and then changes in teachers' attitudes and beliefs (Guskey, 2002). One of the implications is that for the schools where the laptops followed the students, the teachers involved in Emerge may have changed each year. That may not have been sufficient time for this three-stage process to take place.

Finding 3.2

While the Emerge program was designed as a three-year program, some jurisdictions designed their program to have the laptops follow the students. In some cases that meant new teachers joined Emerge each year, resulting in a one-year program for them. According to the Emerge principals, most teachers needed the multiple years of experience to accomplish the necessary shifts in practice and belief.

Principals reported significant changes in classroom practices as a result of Emerge. They said teachers are working more collaboratively and more creatively in seeking ways to engage students in deep learning. In addition, teachers were using the technology to differentiate based on student needs, and teachers were shifting roles to empower students to become more active, independent, discerning learners. Lessons are more interactive and constructivist in approach. Students in such classrooms were provided more choice on assignments, more opportunities for collaboration, more affirmation of their work by persons outside of school. Structures in classrooms have also changed. Teachers accept digital versions of work, students often are provided digital lockers, teachers comment on student work digitally through voice and text comments, and teachers and students often communicate electronically.

Principals also noted that teachers are establishing classroom cultures that are more collaborative, where students are encouraged in peer coaching, peer editing, joint project development, shared learning. That has led to more independence of learning, more curiosity on the part of the student, and more student-centered, project-based and authentic learning. As a result, teachers and students are not locked in the textbook, but are constantly seeking alternate information sources.

A principal noted that "teachers who have been involved since year one have come a long way. Organization and planning has improved tremendously. Keeping tabs on students and accountability has climbed to new heights."

Professional development

The Emerge programs include a range of professional development models. Those include: job-embedded professional development, online and face-to-face communities of practice, and in school coaching and mentoring.

Finding 3.3

The Emerge programs include a range of professional development models. One of the most highly valued by teachers and project leads was the community of practice, linking Emerge teacher to Emerge teacher, as well as experts, resources, and provincial leaders.

Changes in students

According to Emerge leaders, the key changes in students as a result of Emerge are in technology literacy and efficacy, role in learning, and engagement.

Finding 3.4

The key changes in students as a result of Emerge, according to Emerge educators, are in technology literacy and efficacy, in their independence in learning, their increased collaboration, and their engagement in deep learning.

School leaders reported that the change in students due to Emerge was significant related to increased independence of learning, their eagerness to learn, and their joy in expressing what they learned through media. They mentioned increases in critical and creative thinking, collaboration, engagement, and confidence in using the technology efficiently and effectively. Several principals noted that attendance had increased, as had students' organization, pride in their work, and positive behaviors. Students were building expertise in specific technologies and were increasing their competence in knowing – as one principal said, "the right tool for the right job."
The academic area most frequently mentioned by principals was writing, noting that students who would hesitate to write by hand would gladly compose and edit on the computer. Principals also commented on the quality of student products that demonstrated the students' learning.

> *The students have acquired an amazing array of technology skills. Their care and daily use of the laptops has improved dramatically over the past year in particular, and they express a stronger preference for working with the laptops when given a choice. Perhaps most significantly, the students have become much more independent and self-directed in completing tasks, and have acquired the skills to work together and collaborate using online organizational tools such as Moodle. Overall, the students seem more highly engaged with their learning, and seem more confident in their own abilities to solve problems.*
>
> *- Emerge Principal*

According to principals, another key growth area for students was in collaboration. Student use of the laptops resulted in high frequency of student-to-student coaching, support, peer editing, and collaboration on projects.

Principals said that the expectations of students as to their role in learning had shifted, and they now expected active, participatory learning in their classrooms. For older students, principals commented on the advantages to rural students to participate in curricular offerings not available locally.

Rubrics

Rubrics are the current assessment of choice for 21st Century Learning. The primary assessment of 21st Century Skills and Learning in the Emerge program is achieved by the use of rubrics (e.g., for students' digital projects, authenticity, engagement, critical thinking, collaboration, etc.).

Finding 3.5

The primary assessment of 21st Century Skills and Learning in the Emerge program is achieved by the use of rubrics (e.g., for students' digital projects, authenticity, engagement, critical thinking, collaboration, etc.).

Significant correlations

Finding 3.6

Student engagement and jurisdictional readiness are most significantly correlated in 21st Century Skills and Accountability.

The most significant correlations between engagement and the readiness dimensions are in 21st Century Skills and Accountability. Jurisdictions differed in their ability to use the laptops in ways that engage students deeply in learning. The dimension scores that correlated significantly with student engagement were also 21st Century Skills and Accountability. The jurisdictions that were able to achieve high engagement scores using the laptops also integrated 21st Century Skills into their lessons AND established assessments – most often rubrics – that provided them and their students with measures for gauging their success in doing so. While this finding is grounded in correlational (not causal) relationships, it is worth noting. The researchers hypothesize that those schools where key 21st Century Skills were incorporated into lessons and where teachers and students used rubrics to guide and assess the learning translated into deep understandings as to what the 21st Century Skills are, what it means to attain those skills, and what evidence would be required to demonstrate success.

High Marks

As the three-year Emerge program is reaching its end, administrators and teachers are lauding the program for the insights gained into what it means for a school to implement laptop learning with fidelity.

Finding 3.7

School administrators and teachers give high marks to the Emerge program for the insights gained in laptop and mobile learning. They are using these lessons to sustain and expand key elements of Emerge.

School administrators and teachers are reporting that to varying degrees, the Emerge program is shifting classroom practices toward more collaborative, participatory cultures where increasingly students engage in deep inquiry through inquiry, problem-solving, and authentic learning. In some cases those shifts are fairly complete and systemic in Emerge classrooms, in others, the shift is beginning to happen. The progress has been determined, in part, by the extent to which the jurisdiction ensured that teachers experienced multiple years of Emerge. Some of the Emerge programs, when faced with the difficult decision of deciding that the laptops follow the students or the laptops stay at grade level with a teacher, chose to buy a new set of laptops, which enabled them to do both. This was due in part to parental and community influence and enabled them to assure continued growth and participation for both teachers and students.

Scaling Up: Lessons Learned

Now at the end of the third year, participants are actively exploring options for sustainability of the leadership, programmatic, professional development, and technical aspects of Emerge beyond the grant period. The key lessons learned are as follows:

Vision for 21st Century Learning

> *21st Century Learning – learning based on 21st Century Skills, is the "new standard" in education.*
> *- Emerge Project Lead*

21st Century Learning is strongly linked to the engagement of learners and is an essential element of education in the 21st Century. Many Emerge leaders are beginning to expand the Emerge vision for 21st Century Learning to their entire school or districts. A key to success with one-to-one laptop learning is inclusion of the student voice and input.

Leadership and Systems Thinking

> *One-to-one laptops need to be deployed across an entire school with all students and teachers participating in the program in order to change the entire culture of the school.*
> *- Emerge Project Lead*

Administrative support and ongoing involvement of school and district administrators is critical to the sustainability of the initiative. Emerge leaders recognize the need for innovation in building on the success of Emerge. Many discussed the need for a strong, district wide vision for 21st Century Learning, a reliable and robust infrastructure, sufficient access to technologies, and a strong culture of collaborative, inquiry learning. Many reported that they were reconceptualizing and expanding the Emerge vision for their entire school or district. Emerge leaders also acknowledged the time it takes to achieve the significant changes in teaching and learning necessary for 21st Century Learning. Project leads noted the importance of having the teachers fully engaged in the one-to-one laptop learning program for multiple years, and how much that contributed to the success of the program. One of the driving forces for sustainability and scaling up of the successful aspects of the program is parental and community support.

Teaching and Learning

> *While some teachers use the technology in ways that align with their teaching styles, others adapt their style to optimize the use of the technologies. To leverage the technologies fully requires a more experiential, inquiry-based instructional style.*
> *- Emerge Project Lead*

Teachers need to experience and internalize 21st Century Learning if they are to transform their classrooms into 21st Century Learning Environments. The Emerge project leads discussed the importance of viewing the technology as a tool to support learning and instruction, with the

recognition that individual learning preferences must be taken into account (e.g. some students prefer not to use the laptop for some assignments). The transformation of a classroom from traditional teaching to 21st Century Learning happens incrementally, at a number of levels, and requires time to mature.

Access and Infrastructure

The jurisdictions appreciated the opportunity to use Emerge as a "proving ground" for the investigation of wireless networks, laptops and others technologies in schools. Many are concerned about the cost of school provisioned one-to-one laptops and are reconceptualizing Emerge based on their experiences and expertise forged in the program, plus the new devices now available three years after Emerge was launched. For some schools this is taking the direction of innovative practices to support student-owned devices within the school environment, in combination with a bank of school-provisioned devices. Emerge educators have noted the increased number of students who own devices and the interest in a financial model that supports scaling one-to-one to all students. This is evidenced by several examples of Emerge programs that have already scaled the program beyond the initial classrooms (in part due to the pressure by parents to continue laptop access for their children beyond the scope of Emerge).

Emerge participants also acknowledged the critical need for a long-term maintenance, upgrade, and replacement cycles. In the second and third years, Emerge programs were beginning to experience some equipment failure (i.e., laptops, battery life, etc.), even as they are looking to expand their laptop program to more classrooms.

Professional Learning Opportunities

> *Ongoing systematic professional learning for teachers is required to support one-to-one laptop learning. Professional learning related to technologies and pedagogies needs to be just-in-time not just-in-case. Coaching was effective when it addressed just-in-time learning not when the goals were imposed. It is imperative that professional learning is differentiated according to the attitudes, skills and knowledge of the teachers.*
> *- Emerge Project Lead*

While the Emerge programs included a range of professional development models including: job-embedded professional development, online and face-to-face communities of practice, and in school coaching and mentoring, teachers found the peer interactions with other teachers to be most valuable. Recognizing that differentiated instruction is not just good for students, but, is also essential for teachers, Emerge leaders acknowledged the need for hybrid, ongoing professional development learning opportunities. While teachers need to be kept current regarding trends and research, they must also have time to work with one another to understand and operationalize this new information. Thus, Emerge educators found mentoring and coaching were very effective professional development strategies, from this standpoint as it is "just in time," relevant and broken into small pieces that can be slowly adopted, resulting in changes in teaching style. For many Emerge educators, the Emerge Community of Practice events were a new experience and having the opportunity to collaborate with others from around the province was a very valuable experience. Many combined coaching and mentoring with face-to-face and virtual community of

learners interactions, both formal and informal. Professional learning through collaboration using technology was critical to the success of the Emerge program.

Student Engagement

The Emerge program was successful in negating expected declines in student engagement as students moved into upper grades. Project leads noted that student engagement was enhanced through real world tools and real world tasks, that it enabled differentiation, and that there was a gradual shift in responsibilities from teacher to student as the comfort level of teachers increased over time. They also noted that English as a Second Language (ESL) students were engaged and motivated by different media and content. Collaborative projects, multiple ways of presenting content and curriculum was valuable in teaching diverse student learners.

Interestingly, the researchers found that student engagement across jurisdictions was significantly correlated to the degree to which 21st Century Skills were addressed in classrooms, and the degree to which classrooms assessed those skills.

Digital Content

> *Having access to the digital textbook repository was critical and it needs to be opened up to all students. Teachers experienced frustration with their non-Emerge classrooms where they could not give all students access to the digital textbooks. The other area of frustration for the teachers was the inability to access approved novels in digital format – they were forced to scan novels, a very time consuming task. Having sufficient bandwidth to access digital content (i.e. YouTube) is an important consideration. The ability to control access to content should be in the hands of educators not in the hands of IT.*
>
> *- Emerge Project Lead*

Emerge educators found that it was important to approach learning by considering essential, open-ended, deep questions about content that the student then explored using digital resources. Thus, enabling the student to become an informed participant in dialogue, public presentation, peer reviews of student work, etc. They noted that, to be sustainable, digital content must be freely available (e.g., via open source) and commented on the value of the province-provided LearnAlberta.ca resources. In addition to access to digital content, there needs to be a variety of options available with the freedom for individual teachers to choose what works best for them and their students. To expand Emerge, digital content must be freely accessible, of high quality, mapped to standards, and in a multi-media format that students find engaging.

The teacher resources should include a robust online planning environment, a rich software suite, and appropriate web tools and resources.

Sustainability

> *We believe strongly in sustaining the level to which staff and students have risen in terms of technology use for student learning.*
>
> *- Emerge Principal*

The capacity building (i.e., communities of practice, formative assessment reports, professional development, technical support, facilitation of discussions among technology directors and curriculum directors, etc.) throughout the three years was a strong factor in the progress accomplished by Emerge.

The Emerge jurisdictions are reconceptualizing their approach to mobile learning. For many that means:

- Establishing a culture that leverages multiple approaches to ubiquitous technology access including both laptops assigned to students by the district, laptop carts, and student-owned devices
- Creating a culture of inquiry that fully engages teachers and students in authentic, experiential learning
- Using rubric-based performance assessments that fully engage students in self, peer, and teacher-based assessment.

Emerge has been a remarkable proving ground for Alberta educators to pilot, explore, and investigate optimal models for mobile computing. As principals looked beyond Emerge, many positively reflected on their schools' Emerge experiences and discussed ways in which they would continue the essence of the program. Many discussed the need to develop a systemic plan to bring Emerge-like student-centered learning to all students in their schools. Others talked about how much they had learned in Emerge, and how important it was to maintain the momentum and build on the lessons learned in Emerge. For example, one principal said his school would, "continue using the tools in more complex ways [using] new technologies." Others discussed ways in which they would expand elements of the Emerge program to the entire school or district or to special populations. Some discussed how what they learned in Emerge would be carried with them into new locales, "*Next year I will be leaving my current school to open up one of the new ASAP schools. I am excited about this as we will have the resources to move forward with 1 - 1 mobile computing school wide. At my current school, we will be in a rebuilding year with staff next year as many of the teachers are also moving on. We are currently working to help new staff including the new principal, to have a successful transition so that the gains of using 1-1 are not lost.*"

Still others projected increased student responsibilities, such as "having students use the technology to push themselves academically and to use it to interact further with students in other schools, cities and countries;" and continue to allow and encourage students to bring in own devices and help them be anywhere/anytime learners. Others mentioned this idea, but noted the challenges it presents in synchronization with district systems, the technical assistance it would require, and the impracticality at the elementary level. In general, the Emerge leaders had a positive experience in Emerge and were moving forward. For example:

> *We are continuing to work with the high schools our students will attend next year to move forward with sustainability so that our students will continue to be able to use technology anywhere/anytime. I have also been working with a group of schools that intend to begin 1-1 mobile computing projects in the next year. At our school, we are continuing to build the skills of the staff (all staff - not just Emerge staff) and have recently opened a portal for students so that they can bring in*

their own personal devices. We will move forward and expand that initiative in the fall as well. We have also increased our overall ratio of students to computers in the school to 2/1 so that all of our students will continue to have easy access to technology. We will also continue to fund (out of our school budget) for technology lead teacher time and an increased level of support from our technical support analyst in order to ensure seamless access for all students and staff. As well, we are continuing to increase the robustness of our wireless network so that it can support the number of personal devices we expect students to bring in the future.

- Emerge Principal

Key to the progress of the Emerge one-to-one laptop implementation was the collaborative problem solving among curriculum, instruction, and technology professionals in order to tackle key issues and challenges.

One of the top issues was the challenge of sustaining the Emerge model without continued financial support. While finances were noted as a barrier, they didn't seem to deter leaders from expanding elements of Emerge to whole schools or the district. Those include: district portals, professional development, whiteboard expansion, and Moodle platforms. Often such expansions included reconceptualizing the one-to-one model. Some leaders were looking to the student-owned device model with a bank of school-owned laptops as supplements, some were planning to use laptop carts, others mentioned a one-to-two ratio of laptops or devices to student model, and many were using hybrids that included various combinations. One commented that the whole school was moving to laptops versus the former model of desktops due to the positive experience in Emerge classrooms.

At the end of the project, Emerge educators conveyed the tremendous effort it took to accomplish the shifts in teaching and learning toward inquiry, experiential, and authentic learning, and tremendous accomplishment they feel in moving several milestones down the path toward 21st Century learning.

Question 4: Readiness for Systemically Advancing 21st Century Learning/Technology

Research question: What is the level of jurisdictional and provincial readiness for systemically advancing 21st Century Learning and effective uses of technology in learning?

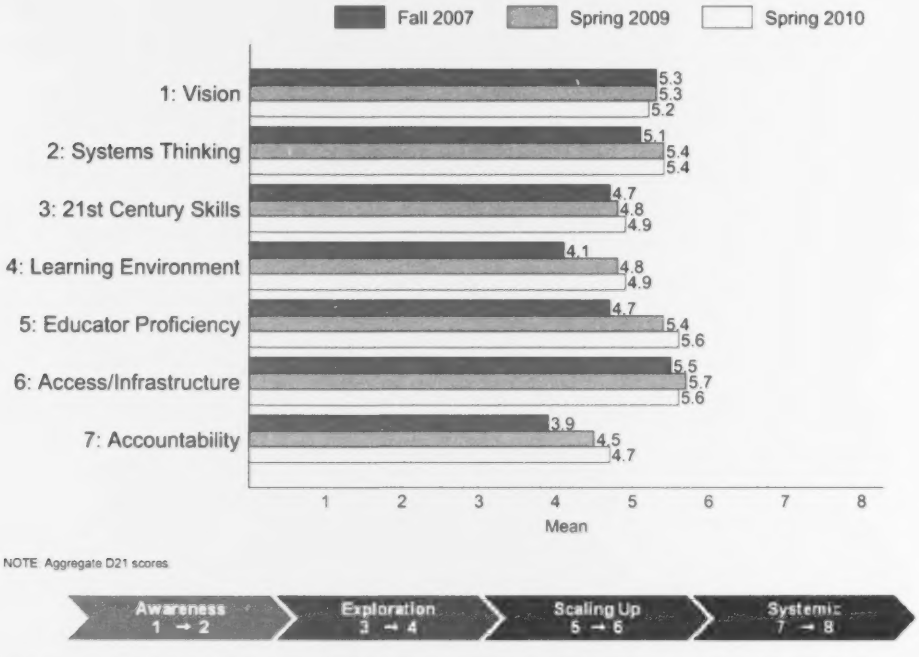
Finding 4.1

Over the course of the three years, the readiness of the Emerge programs for advancing 21st Century Learning and effective uses of technology have steadily increased.

The readiness of the 20 Emerge jurisdictions for 21st Century Learning and effective uses of technology within the one-to-one laptop learning program increased incrementally over time. As discussed in the Executive Summary, the Emerge researchers used Metiri's Dimensions21 framework to gauge the readiness of the Emerge jurisdictions for 21st Century Learning and effective uses of technology.

The baseline data were collected in Fall 2007. By Spring 2009 significant increases had been registered for all 7 Dimensions of Readiness, per the Dimensions21™ framework. Those upward trends were continued into the third year of Emerge, with all dimensions except vision.

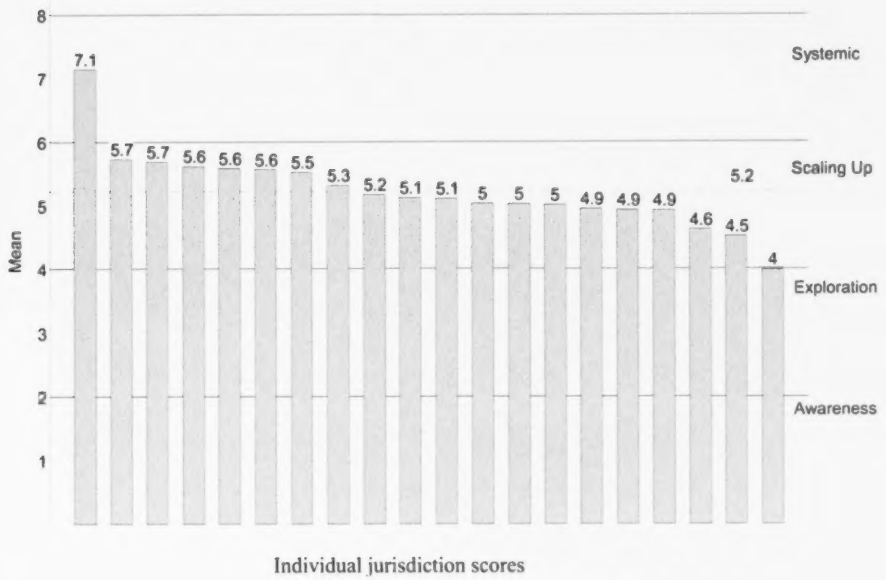
Figure 33: Trends in the 7 Dimensions of Readiness for 21st Century Learning



Year 1 N =108 Teachers 46 Administrators Year 2 N =129 Teachers 46 Administrators Year 3 N =116 Teachers 53 Administrators

Most of the 20 Emerge jurisdictions' average scores across the 7 dimensions clustered within the *Scaling up* stage of readiness (see Figure 34). While one jurisdiction has just entered that stage with a score of 4.0, most were spread across the stage with scores from 4.5 to 5.7, with one jurisdiction in the *Systemic* stage, at 7.1. That suggests that the Emerge program was institutionalized within the Emerge classrooms, and jurisdictions were beginning to consider how they might expand program elements to other classrooms within the school or district.

Figure 34: Average score across all the 7 Dimensions of Readiness for 21st Century Learning for each of the 20 jurisdictions.



Source: *Spring 2010 surveys. N=116 teachers. N=53 administrators.*

Dimension 1: Forward Looking, Shared Vision

Discussion

Vision matters. A *Forward Looking, Shared Vision* serves as a unifying and energizing force of change within a school system. It serves as a vehicle for setting targets that align to all curricula, instruction, assessment, scheduling, progress reporting, and community communications.

Finding 4.2

Over the course of the three years, Emerge teachers and administrators have developed a deeper understanding of and commitment to the vision for 21st Century Learning in their respective Emerge projects.

The Emerge scores on *Forward Looking, Shared Vision* have remained consistent over the three-year implementation, yet there are some marked differences in administrator and teacher scores. While administrators' scores on *Forward Looking, Shared Vision* declined slightly (from 5.3 at baseline to 5.0 in Spring 2010) they remained in the Scaling Up area. Teachers' scores showed a marked increase (from 5.2 at baseline to 5.7 in Spring 2010), indicating that after their experience with Emerge, they are clearly seeing and committing to a *Forward Looking, Shared Vision* for 21st Century Learning. There was a slight increase in the percentage of teachers who reported they were supportive or extremely supportive of the vision for 21st Century Learning from Fall 2007 (87.7%) to Spring 2010 (92.1%).

Spring 2010 Stage of Readiness: Forward Looking, Shared Vision

Awareness	*Exploration*	*Scaling Up*	*Systemic*
Educators are only now building awareness of what 21st Century Learning is and why it is important. Even those efforts are often fragmented.	The district or school leaders are actively investigating, discussing, and debating the issue of 21st Century Learning and educational technology. Educators may be attending conferences, taking classes, visiting pioneering districts, and building a knowledge base that is informed by research. At this stage leaders would be reaching out to the community, parents, businesses, industry, and students to join the discussions.	At this stage, a vision for 21st Century Learning and educational technology is emerging in pockets across the district or within the school. Some departments, grade levels, or even schools have collectively established a forward looking vision, and leaders within the district are building on that work to draw all sectors into a collective vision.	There is a forward looking vision in place for 21st Century Learning. That vision was collaboratively developed, widely communicated, and is grounded in educational research. Educators at all levels, the community, and other stakeholders are fully committed to the vision.

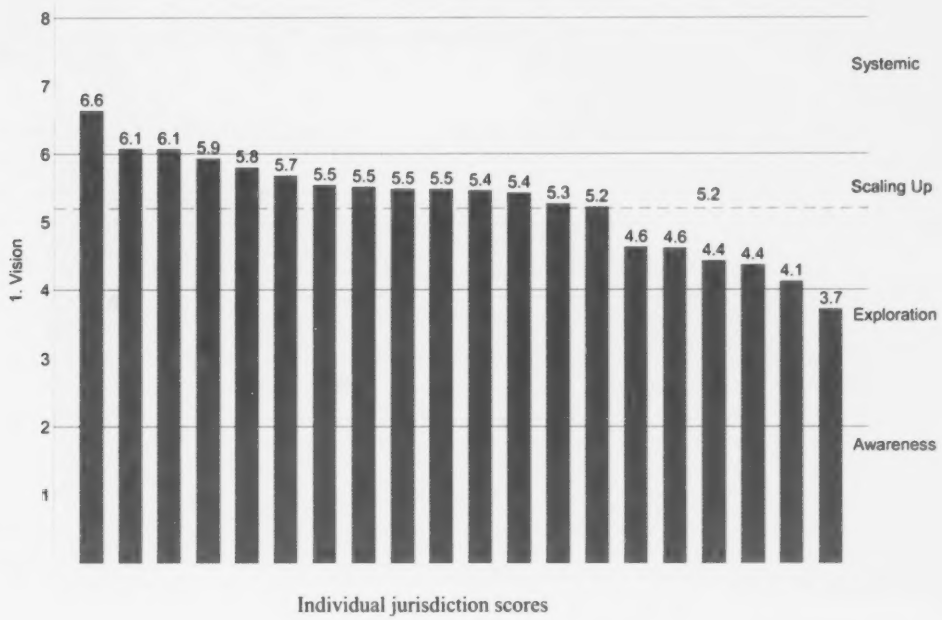
5.2 (remained fairly consistent from Fall 2007)

It seems that administrators were fairly comfortable with the initial vision the jurisdiction included in its proposal to Alberta Education, which resulted in the Emerge grant award to their district. However, teachers only became sufficiently familiar in the second year with what that vision meant in their classrooms, and that is when they began to more fully commit to their jurisdiction's Emerge vision.

One of the key challenges for sustainability in this area is the segmentation of the Emerge Project from the mainstream of the school. By the third year of Emerge, many school leaders were beginning to discuss how they could extend the vision throughout the school.

There was a great deal of variability across jurisdictions on this measure, as displayed in Figure 35. While there were three jurisdictions that had moved into the systemic stage of readiness, most jurisdictions were in the scaling up stage, and one was still in the Exploration stage.

*Figure 35. Distribution of **Vision** scores by jurisdiction based on Spring 2010 surveys*



Source: *Spring 2010 surveys. N=116 teachers. N=53 administrators.*

It should be noted here, that this Vision dimension is focused on the vision for the Emerge classrooms and may not extend beyond Emerge across the school. That said, many principals are suggesting that Emerge has influenced the school culture related to 21st century learning and technology.

Dimension 2: Systems Thinking

> *The degree of support (attitude, skills and knowledge) of the school administration is axiomatic to the success of the project. The school administration is instrumental in creating a school culture and aligning all initiatives in a common direction that supports 21st Century learning (including one-to-one laptop learning). Having divisional alignment with the goals of the Emerge project has enhanced the implementation of the Emerge project.*
>
> *- Emerge Project Lead*

Discussion

Systems Thinking is defined here as policymaking and implementation that acknowledges and accounts for the interrelationships among all parts of the system in achieving goals effectively and efficiently.

Finding 4.3

Most of the Emerge school leaders have maintained strong support for Emerge one-to-one laptop learning throughout the program, while support from others has waned.

Without systemic leadership that employs vision, along with alignment of goals with curriculum, instruction, assessment, and resources, the Emerge program would certainly falter.

The Emerge teachers and administrators survey responses in Spring 2010 placed Emerge in the *Scaling Up* stage of readiness (5.4 on an 8-point scale, as compared to the baseline score of 5.1 in Fall 2007).

Spring 2010 Stage of Readiness: Systems Thinking

Awareness	*Exploration*	*Scaling Up*	*Systemic*
At this stage, the thinking and planning in the district or school for 21st Century Learning is very ad hoc, typically by individual educators or with certain programs.	A few educators and some leaders are taking the long-view, thinking deeply about where the key leverage points are in the system that will positively shift teaching and learning in ways that fully prepare students for the 21st Century. In fact, some are exploring ways various new approaches can be used, and are working hard to ensure that all stakeholders are not only ready for such change but also are eager and excited about it. They are starting with some key schools and classrooms, modeling new cultures of learning that empower teachers and students.	The leadership team as a whole is committed to, and is taking responsibility for, systematically advancing toward 21st Century Learning. They have identified the new policies and practices required to achieve the vision, are scaffolding teachers into 21C, are setting high expectations for shifts toward 21C, and are creating the professional communities of practice as support structures critically necessary for change. While not yet fully aligned, all elements of the system are encouraged, empowered, and expected to make changes.	Leaders are using the district vision for 21st Century Learning as a design element in policy development, setting of standards, and prioritizing investments. They have set high expectations and definite timelines for implementation of 21st Century Learning. As a result curriculum, instruction, assessment, professional development, and accountability are aligned to that vision. There is a culture of creativity and innovation grounded in research that ensures the district will stay current.

5.4 (an increase from 5.1 in Fall 2007)

The researchers looked across the projects and found that the implementation of Emerge varied greatly across jurisdictions, across schools within jurisdictions, and across classrooms within the

schools. One of the major shifts from Year 2 to Year 3 was the move toward broader, more systematic and collaborative decision making in schools as to systemic implementation of classroom practices. The percentage of teachers indicating that there was a systemic approach, which ensured all students of a consistent approach to 21st Century Learning and technology, regardless of classroom assignments and students' schedules, increased from 22% at baseline (2007) to nearly a third (30%) by Year 3.

Table 10: Systemic aspects of implementation of classroom practice. Teachers were asked, "In my school teachers in the same grade or subject areas"

	Year 1	*Year 2*	*Year 3*
Share little or no common understanding about evidence-based practices. Teachers decide individually whether and how they will make instructional decisions.	13%	16%	11%
Share some common understanding about evidence-based practices; however, some teachers implement these uses and others do not.	61%	63%	54%
Share a common understanding about evidence-based practices; there are clear expectations that such practices will be used.	22%	20%	30%

NOTE: *The practices indicated in this question provide insights into whether schools are systematically adopting evidence-based practices or are leaving such adoption to individual teacher choice.*
Year 1. N=108 teachers. Year 2. N=129 teachers. Year 2. N=129 teachers. Year 3. N=116 teachers.

The percentage of teachers who said that they are "sometimes" or "always" provided the resources and support to redesign classrooms into 21st Century learning environments has stayed strong, slightly increasing from 73% in Fall 2007 to 78% by Spring 2009 and remaining at 78% in Spring 2010. One of the ways such support manifests itself is in the nature of the professional development provided Emerge teachers. Teachers indicated that the quality of such professional development has increased overall, but especially in three areas identified below.

Table 11: Percentage of teachers saying this attribute is "always" evident in professional development provided by their school or jurisdiction

Attribute of professional development	*Fall 2007*	*Spring 2010*	*Difference*
Prepares teachers to discuss/assess student work produced with technology.	10%	22%	+12%
Inclusion of opportunities for teachers to see actual *examples of 21st Century Skills* applied to learning in classrooms similar to theirs.	6%	17%	+11%
Provision of *time for teachers to work together*, and to discuss and plan for using technology in the classroom.	12%	22%	+10%

Year 1. *N* = 108 teachers. Year 2. *N* = 129 teachers. Year 3. *N*=116 teachers.

These attributes enable teachers to plan with colleagues for educational technology and 21st Century Learning in their classrooms. Many of the Emerge projects narrowed their focus at the beginning of Year 3 to enable them to address select 21st Century Skills in depth, rather than a broader array of such skills. That resulted in more targeted professional development and more explicit work in the classroom to address this reasonable set of 21st Century Skills.

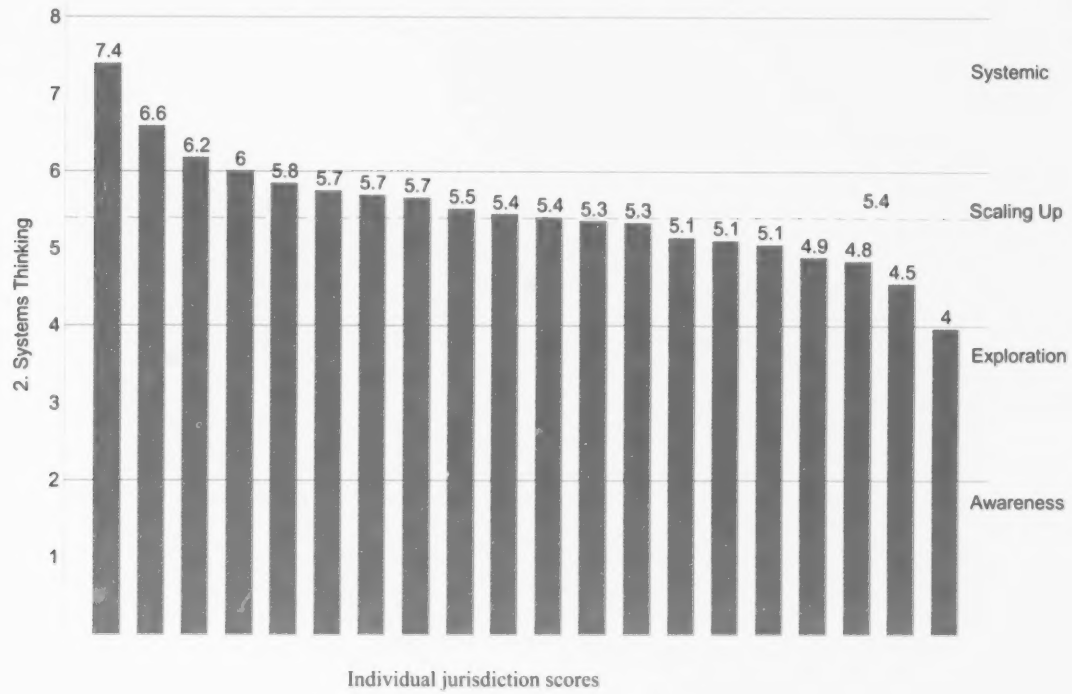
A critical aspect of systems thinking is the enactment of policies supportive of the vision. The percentage of teachers indicating that 21st Century Skills are "always" purposefully incorporated

into their learning standards jumped from 20% at baseline (2007) to 36% in Year 3. In contrast, the percentage of administrators who indicated that teachers "always" use research on effective uses of technology or innovative uses of technology when they design or implement curriculum decreased 9% from 43% at baseline to 31% in Spring 2010.

Another of the key indicators of such policies is the Acceptable Use Policy for the laptops. Given the work with Web 2.0 tools and exploring the opportunity for student-owned devices, school jurisdictions are exploring and/or developing policies and establishing practice. This is a potential growth area for the jurisdictions as they consider the implications for 24-hour-per-day, 7-days-a-week use by students in the school, home, and community.

Again, the distribution of the Emerge jurisdictional scores for the Systems Thinking dimension varied considerably. For this dimension, four jurisdictions were in the Systemic stage, with the majority in the Scaling up stage.

*Figure 36. Distribution of **Systems Thinking** scores by Jurisdiction: Spring 2010*



Source: Spring 2010 surveys. *N*=116 teachers. *N*=53 administrators.

Dimension 3: 21st Century Skills and Instructional Approaches

Discussion

The Partnership for 21st Century indicates "To successfully face rigorous higher education coursework, career challenges and a globally competitive workforce…schools must align classroom environments with real world environments by infusing 21st Century Skills into their teaching and learning," (Partnership for 21st Century Learning, 2010).

Finding 4.4

Over the course of the first three years of Emerge, the perception of teachers as to the relevance of the 21st Century Skills to content has shifted from highly valuing productivity and communication to more highly valuing the use of tools in critical thinking, creativity, and ethical use.

By Year 2 – and carrying into Year 3 – most jurisdictions realized the impossibility of addressing all of the twenty-plus 21st Century Skills and adopted a "less is more" philosophy, focusing on only a few skills. By narrowing the focus to a few 21st Century Skills, educators have been able to drill down and deepen learning about a few skills, rather than superficially addressing all. According to administrators, in Year 3 the top three skills that were addressed through formal initiatives were *Teaming and Collaboration, Critical Thinking,* and *Self-Directed Learning*.

The educators' survey responses in Spring 2010 placed Emerge in the Scaling Up stage of readiness for Dimension 3 (4.9, with the baseline score at 4.7).

Spring 2010 Stage of Readiness: 21st Century Skills and Instructional Approaches

Awareness	*Exploration*	*Scaling Up*	*Systemic*
While educators are aware of the concept of 21st Century Skills and Learning, there are still significant misconceptions as to what truly constitutes 21st Century Skills, and little knowledge of the types of teaching and learning activities that are likely to promote these skills.	Leaders in the system who are advocating for 21st Century Skills have some familiarity with the cognitive science supporting 21st Century Skills and the types of practice that are likely to build these skills. This understanding is being communicated to some educators in the system who may be implementing portions of that practice, but these implementations are "pilots" and not widespread.	Formal processes for disseminating information and building 21st Century teaching and learning practices are being established. Professional development is being designed, piloted and refined. Most teachers are building skill in promoting 21st Century Skills and Learning..	In virtually every classroom, significant purposeful effort is being made to promote 21st Century Skills and Learning for all students. 21st Century Skills have been integrated into all curricula as appropriate and rich, and authentic learning is a core characteristic of virtually all instruction.

4.9 (an increase from 4.7 in Fall 2007)

The skills that teachers identified as most relevant to the content in Spring 2009 and Spring 2010 differed considerably from those considered most relevant in Fall 2007. As indicated in Table 12 whereas the top priorities in Fall 2007 were focused on the use of the tools for productivity, by the end of Year 2 and Year 3, teachers' priorities had shifted to the students' uses of the tools to think, create, and work collaboratively in teams, as well as to be flexible and adaptable and information literate.

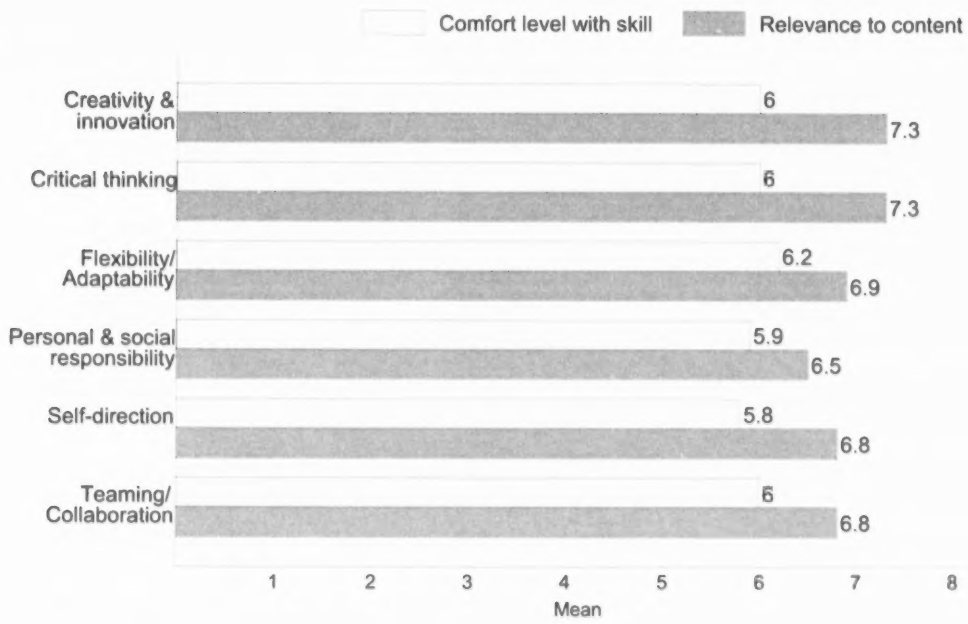
Table 12. Top five 21st Century Skills identified by teachers as most relevant to content

21st Century Skill	Fall 2007	Spring 2009	Spring 2010
Personal & Social Responsibility		1	
Critical Thinking		2	1
Flexibility/Adaptability		3	2
Creativity & Innovation		4	5
Teaming/Collaboration	1	5	3
Productivity	2		
Interactive Communication	3		
Effective Use of Real-World Tools	4		
Prioritizing, Planning, & Managing for Results	5		
Information Technology			4

Year 1. *N* = 108 teachers. Year 2. *N* = 129 teachers. Year 3. *N*=116 teachers.

A review was done of the data on the top teacher priorities based on relevance of the 21st Century Skills to content. It reveals that both the teachers' comfort levels, and the administrators' reports on the extent to which formal initiatives on the skills are underway, lag behind the levels of relevance. The gap between the teachers' comfort levels and their perceptions of relevance of these skills to their content is greatest for *Prioritizing, Planning and Managing for Results* (1.6), *Cross-Cultural Skills* (1.4), *Productivity* (1.4), *Flexibility and Adaptability* (1.3), and *Creativity and Innovation* (1.3).

Figure 37. Teacher and administrator responses regarding 21st Century Skills



N=116 teachers and 53 administrators.

To complement the survey data, the research team conducted site visits in all jurisdictions at four different time periods: Fall 2007, and then Spring 2008, 2009, and 2010. Each site visit included three classroom observations. While it is not expected that the teacher's every lesson would address every 21st Century Skill, the school should be looking for a balance across classrooms. The expert researcher looks for evidence of eight 21st Century Skills with the following protocol: this skill could not be included in the lesson (N/A); the skill could be included in the lesson; the skill was promoted by the classroom environment; explicit instruction occurred and/or promoted the skill by the content selected for the lesson. If the skill could be included but was not, it was scored as Not at all. If the skill was included then it was scored in terms of One instance, Somewhat evident, or Substantially evident.

In Fall 2007, the three top skills that scored as being Evident (Somewhat or Substantially) in the lessons were *Self-directed Learning*, *Problem Solving*, and *Information and Technology Literacy*. In Spring 2008, both *Self-directed Learning* and *Information and Technology Literacy* were two of the three most frequently observed, with *Teaming and Collaboration* being the most frequently observed. In Spring 2009, *Collaboration and Teaming*, *Critical Thinking* and *Effective Communicator* were in the top three. In Spring 2010 *Self-directed Learning*, *Effective Communication*, and *Visual Thinking*, were the top three, with *Critical Thinking* and *Teaming and Collaboration* close behind. It is evident over the four reporting periods that the teachers' emphases on various 21st Century Skills is somewhat fluid. However, there are still a large percentage of these skills that are not being observed as either being promoted within the learning environment, through explicit instruction, or embedded within the selected content.

Additional indicators of 21st Century Skill attainment reside in the type and quality of student work. Two key factors that influence the quality of student work are student choice and student creativity. The following charts indicate the percentage of work assigned by teachers in various categories. While student production of technology products defined by teachers continued to represent the highest percentage of teachers, student-designed technology-based products did increase slightly in Year 3. See Table 13 and Table 14. On average, administrators reported similar trends.

Table 13: Percentage of classroom work in the following categories according to teacher

	Fall 2007	Spring 2009	Spring 2010
Written products that require creation of original content	30%	38%	37%
Applying skills to problems that are complex & emulate work done in the real world	36%	43%	41%
Technology-based products defined by the teacher	41%	44%	46%
Student-designed, technology-based products	24%	24%	27%

Source: Teacher Survey. Fall 2007: *N*=108; Spring 2009: *N*=129: Spring 2010: *N*=116.

Table 14: Percentage of classroom work in the following categories according to administrator

	Fall 2007	Spring 2009	Spring 2010
Written products that require creation of original content	37%	33%	40%
Applying skills to problems that are complex & emulate work done in the real world	34%	29%	40%
Technology-based products defined by the teacher	40%	38%	43%
Student-designed, technology-based products	19%	20%	26%

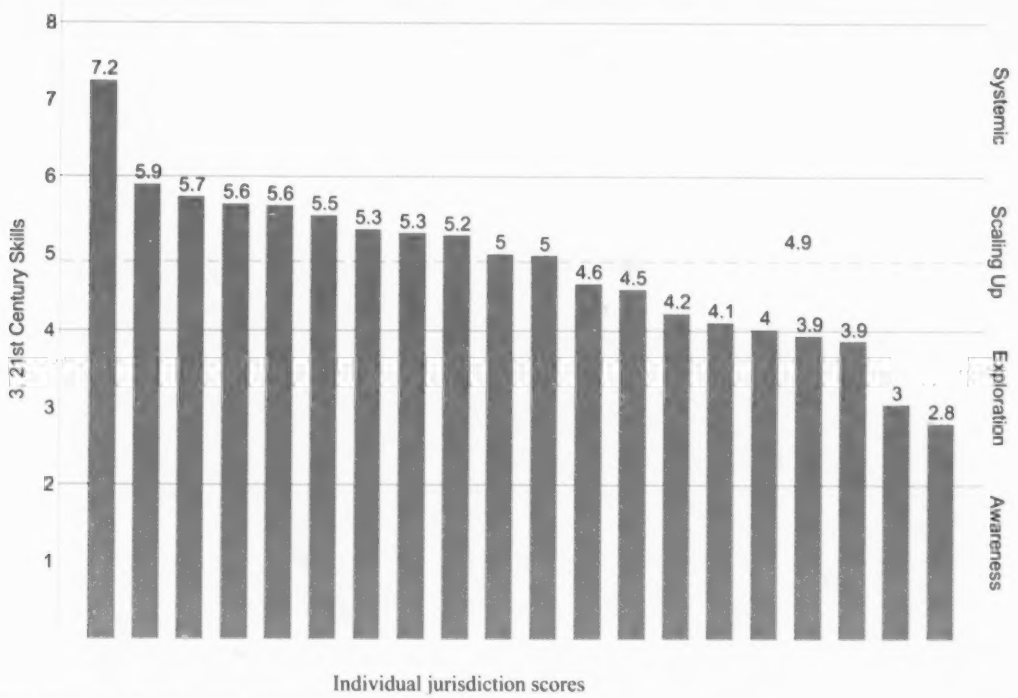
Source: *Administrator Survey. Fall 2007: N=46; Spring 2009: N=46; Spring 2010: N=53*

While Emerge students are beginning to exhibit some progress in attainment of select 21st Century Skills, there remain indications from administrators that, in some classrooms, students do not yet have the opportunity to develop or demonstrate such attainment.

There appears to be steady growth in the teacher assignments that include either teacher-defined or student-designed technology-based products. That said, the percentage of teachers and administrators who report providing their students with such opportunities remains under 50%.

For this dimension, only one jurisdiction was in the *Systemic* stage, the majority were in the *Scaling up* stage, and four were in the *Exploration* stage.

*Figure 38. Distribution of **21st Century Skills** scores by Jurisdiction: Spring 2010*



Source: *Spring 2010 surveys. N=116 teachers. N=53 administrators.*

Dimension 4: 21st Century Learning Environments

Discussion

Phil Schechty (2002) writes, "Schools cannot be made great by great teacher performances. They will only be made great by great student performance."

Finding 4.5

Classroom practices in the Emerge Project have shifted during the first three years toward 21st Century Learning, while maintaining a modicum of traditional, didactic teaching.

The *21st Century Learning Environment* Dimension is undoubtedly the most indicative of the progress the jurisdiction is making in changing classroom practices in ways that would advance 21st Century Learning. The researchers collected data on this dimension from the educators' surveys, the site visits, and the student surveys. Overall, classroom practices have shifted toward more student-centered learning, while maintaining some traditional, didactic teaching. That balance between basic versus higher order thinking, and between coaching and experiential learning versus didactic teaching, varies considerably across the Emerge jurisdictions and classrooms.

Emerge teachers and administrators survey responses in Spring 2010 placed Emerge in the *Scaling Up* stage of readiness for Dimension 4 (4.8 on an 8-point scale, as compared to the baseline score of 4.1 in Fall 2007). This topic is also addressed in Question 1, so the findings from that section should also be considered here. (See Finding 1.2.)

Spring 2010 Stage of Readiness: 21st Century Learning Environments

Awareness	*Exploration*	*Scaling Up*	*Systemic*
Teachers and school administrators are slowly building understanding of how classroom practices have to change. However, they have yet to act on those ideas, so practices look as they did a decade ago. In general, teaching is didactic, teachers are isolated, students are not engaged, they are passive learners, and they are graduating into a world unprepared for the 21st Century. At this stage, technology is often used in a supplemental way for drill and practice, note taking, or to increase productivity.	The leaders are asking all educators to dedicate time to acquiring deeper understanding of 21st Century Learning and to piloting those concepts in schools and classrooms. Pioneering groups are recognized for their innovations and their thoughtful reflections and applauded for documenting their work in order to share it. Leaders are beginning to schedule professional development aligned to the vision. A backward mapping or logic model is available, which clearly articulates pathways and essential conditions and characteristics of a school system that is ready to provide 21st Century Learning. That includes innovative uses of technology such as data collection and analysis, multimodal learning, critical and creative thinking, and collaborative learning.	Many classrooms and schools have been at least partially transformed into 21st Century Learning environments. A culture of high expectations, innovation, and enabling communities of practice is in place, along with metrics and accountability milestones to ensure incremental progress. Professional development is embedded in the school day, facilitated in part through reflective, active communities of learning. Leaders are building the capacity of all to meet and exceed the incremental goals and long-term vision.	Innovative communities of learning have been established in every site throughout the district. Within such cultures, educators have been empowered to shift practices in ways that fully engage students in deep, authentic learning, which is facilitated by thoughtful uses of technologies, including Web 2.0. Teachers are making collaborative decisions informed by research and professional literature, discussing and debating the concepts with colleagues, and then jointly shifting practices. Students and teachers have access to resources 24/7 via technology. Students are guided by teachers in self and peer assessment.

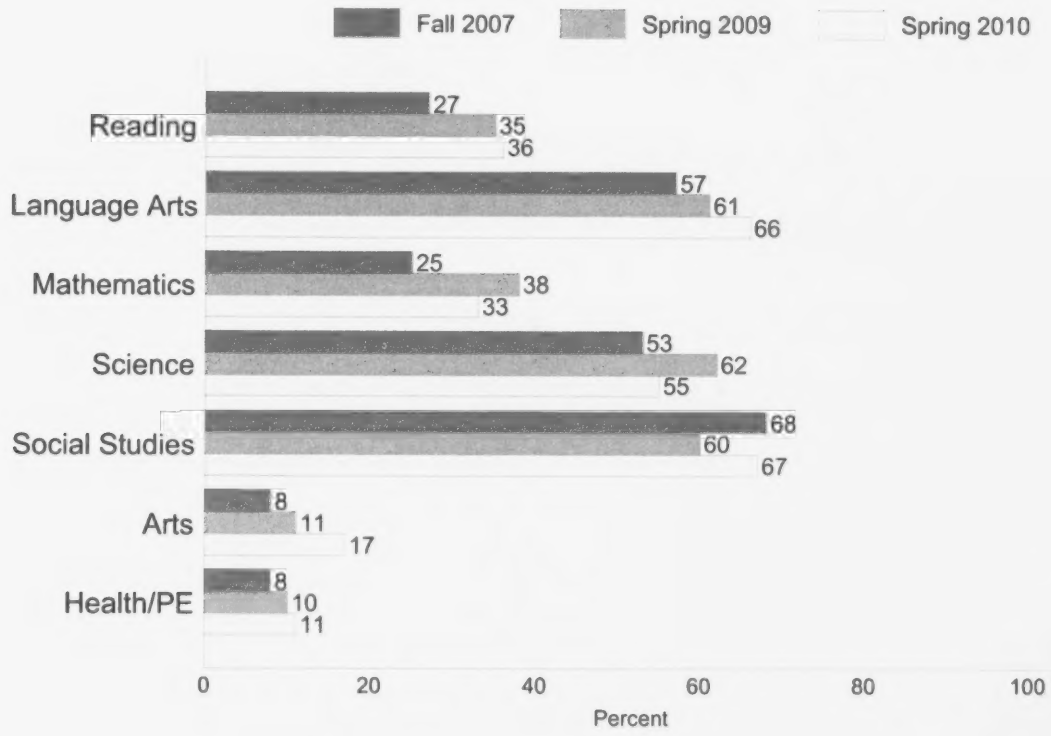
4.8 (an increase from 4.1 in Fall 2007)

In some of the classrooms, I see a shift in how children are learning. The students are challenged to solve problems and think critically. The teacher facilitates and guides students to gain understandings and deepen their learning.
- Emerge Principal

Teachers in the Emerge Project have made significant strides toward 21st Century Learning. They now understand more clearly what the vision looks like, translated into practice. For example, the percentage of teachers agreeing or strongly agreeing with the statement that "Teachers in the Emerge Project know what the school's expectations are for student attainment of 21st Century Learning," increased from 67% in Year 1 to 92% in Year 2, leveling off at 84% in Year 3.

The percentage of teachers reporting that technology played a significant role in the core content areas increased significantly over the first three years of the Project. For the core areas of reading, language arts, mathematics, science, and social studies, the increases in reports of significant role were, respectively, +36%, +68%, +33%, +57%, and +67%. See Figure 39.

Figure 39. Trends in the percentage of teachers indicating that technology plays a moderate or significant role in building skills of proficiency in their students in the following content areas

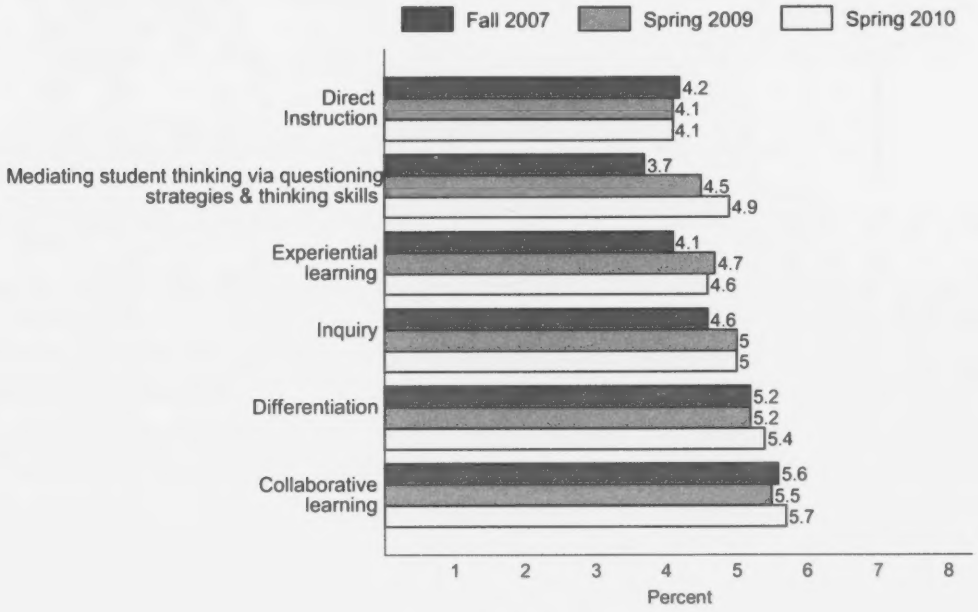


SOURCE: *Teacher survey. Fall 2007, n=108; Spring 2009, n=129; Spring 2010, n=116.*

Emerge teachers continue to indicate that student-centered learning is important and they are making progress in incorporating student-centered pedagogies into their classrooms. These

pedagogies engage students in collaborative inquiry, highly experiential, complex learning that often is differentiated for individual students or groups of students.

Figure 40: Trends in teachers' ratings as to the current use of various instructional strategies



SOURCE: *Teacher survey. Fall 2007, n=108; Spring 2009, n=129; Spring 2010, n=116.*

The use of technologies by students in the Emerge classrooms continues to grow each year. According to Emerge teachers, the use of technology by students within each of the following practices has increased in frequency over the three years of the project:

- Solve real-world problems
- Produce multi-media, web, digital audio, digital video, or presentation products
- Conduct online research
- Use of the Internet to collaborate with students in local school, district, or community
- Online communication with experts, peers, and others

It should also be noted that a gap remains between teachers' original perception of how important these strategies are for students and the teachers' current use. This is due, in part, to the increased awareness on the part of the teacher as to how important 21st Century Skills are to their students' future success.

Despite the increases described above, administrators say that their school's current use of three key approaches to learning seriously lag behind the level of importance they place on these skills for today's learners:

- Solving of real-world problems

- The use of the Internet to collaborate with students within the district, school, or classroom
- Online communication with experts, peers, and others

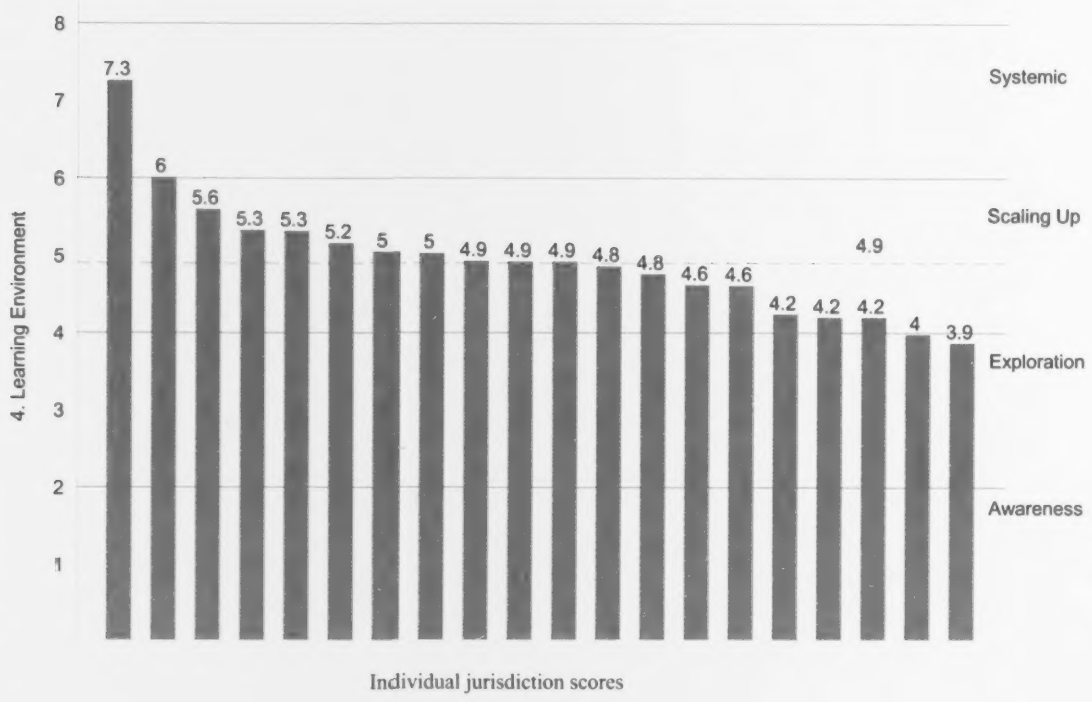
Finding 4.6

Nearly a third of Emerge teachers indicated that interactions with students' parents is "strongly facilitated by technology."

An area where teachers noted significant gains was in parental and community involvement that was strongly facilitated through technology. For example, 45% of teachers in Spring 2010 said that technology strongly facilitated interactions with parents, up from only 18% in Fall 2007. Similarly, 33% of teachers in Spring 2010 said that technology strongly facilitated parental involvement in students' schoolwork, up from 21% in Fall 2007.

For this dimension, two jurisdictions were in the systemic category, six were in the Scaling up stage, and 12 were in the Exploration stage.

*Figure 41. Distribution of **Learning Environment** scores by Jurisdiction: Spring 2010*



Source: *Spring 2010 surveys. N=116 teachers. N=53 administrators.*

Dimension 5: Educator Proficiency in 21st Century Learning

It is imperative that professional learning is differentiated according to the attitudes, skills and knowledge of the teachers.
- Emerge Project Lead

Discussion

According to Stanford professor, Linda Darling-Hammond (2010), "It is teachers who have a major influence on the most valuable asset a nation has – its youth."

Finding 4.7

Teacher proficiency with technology in advancing academic proficiency and 21st Century Skills has increased over the three years of Emerge.

This dimension of educator proficiency evaluates the proficiency of teachers in using technology and 21st Century Learning in lesson design, classroom activities, student assessment, and professional practice. While their proficiency with technology is important, the true indication is how teachers are able to combine strong pedagogy that supports student-centered learning, emergent research from the learning sciences on how people best learn, and features of contemporary technologies. Teachers and administrators survey responses in Spring 2010 placed Emerge in the Scaling Up stage of readiness for Dimension 5 (5.6 on an 8-point scale, as compared to the baseline score of 4.7 in Fall 2007).

Spring 2010 Stage of Readiness: Educator Proficiency in 21st Century Learning

Awareness	*Exploration*	*Scaling Up*	*Systemic*
While teachers are aware of the concept of 21st Century Skills, there is a misconception that these skills have to do with technology alone. While teachers may have some proficiency in more traditional practices for building the skills, the connection of those practices to 21st Century Skills and Learning has not been made.	Teachers are beginning to understand the nature of 21st Century Skills and Learning but are only in initial stages of professional development to help them understand the cognitive science related to these skills. They are beginning to experiment with practices that promote 21st Century Skills but feel the need to expand their knowledge.	Formal professional development in 21st Century Skills and Learning is increasingly available. Teachers are fluent in the language of 21st Century Skills and Learning and assistance in building skill for supportive practices and opportunities to evaluate personal readiness for those practices are widely available.	All teachers are expected to be expert both in knowledge of the science related to 21st Century Skills and Learning and in the practices known to develop these skills. These concepts have been embedded in all professional development related to teaching and learning and teacher skill in this area can be observed in virtually every classroom.

5.6 (compared to 4.7 in Fall 2007)

As teachers' understanding of technology and 21st Century Learning increased over the three years of Emerge, their self-reported levels of expertise also increased significantly. While at baseline (2007) only 11.5% considered themselves expert, that number increased to 19% in Year 2 and to 19% in Year 3.

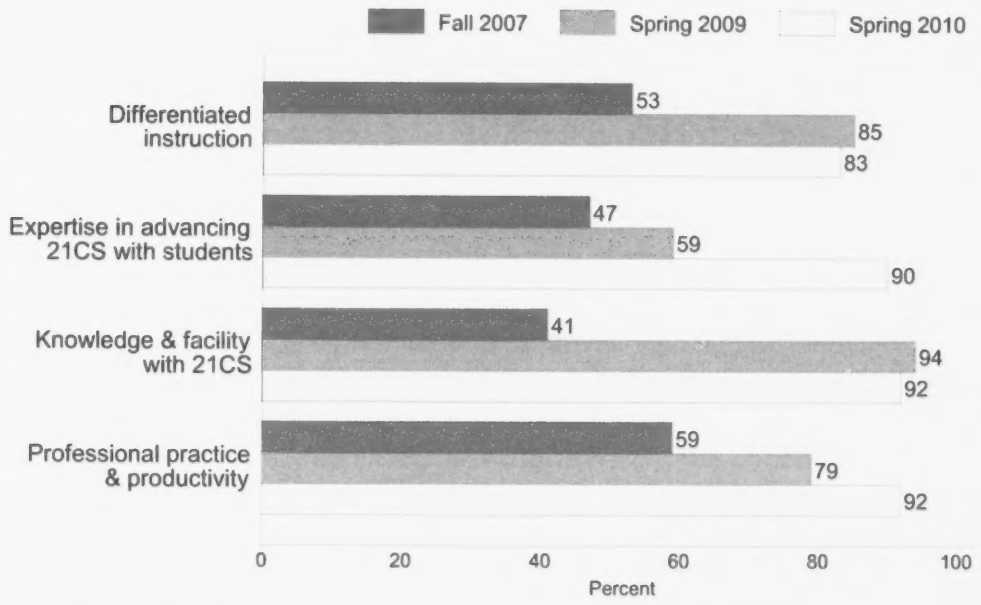
Comprehensive professional growth opportunities need to be available for educators to build their capacity to advance the Emerge vision. Emerge educators have participated in various jurisdictional and provincial professional learning opportunities. Further, they have been actively involved in sharing their expertise through various presentations. Many jurisdictions have

established supports for their own local community of practice. For example, one jurisdiction created an online space in Google Docs that includes: a list of team members; project news; research; journal entries; professional learning events; files to share; and a calendar. Within the section, "Professional Learning Events," teachers in each school record the professional learning activities they plan to participate in. After attending the activity they note some information about the learning experience. This ongoing record reflects the diverse nature of the professional learning that individuals have engaged in as part of building capacity.

The Emerge online environment has been created to support educators and provide them with a space to share their work and reflections. Further, they can share exemplars of student work that show the various types of activities and projects students are engaged in with the use of their laptops. Such an online environment fosters greater communication about the one-to-one laptop project, as well as what individuals are doing to advance their own work and the work within the Emerge initiative.

Extensive professional development opportunities, including such communities of practice have contributed to the incremental increases in teacher proficiency among Emerge teachers. As shown in Figure 42, most administrators agree that Emerge teachers are prepared to teach 21st Century Skills.

Figure 42. Percentage of administrators' reporting that teachers are prepared to use 21st Century Learning to accomplish the following:

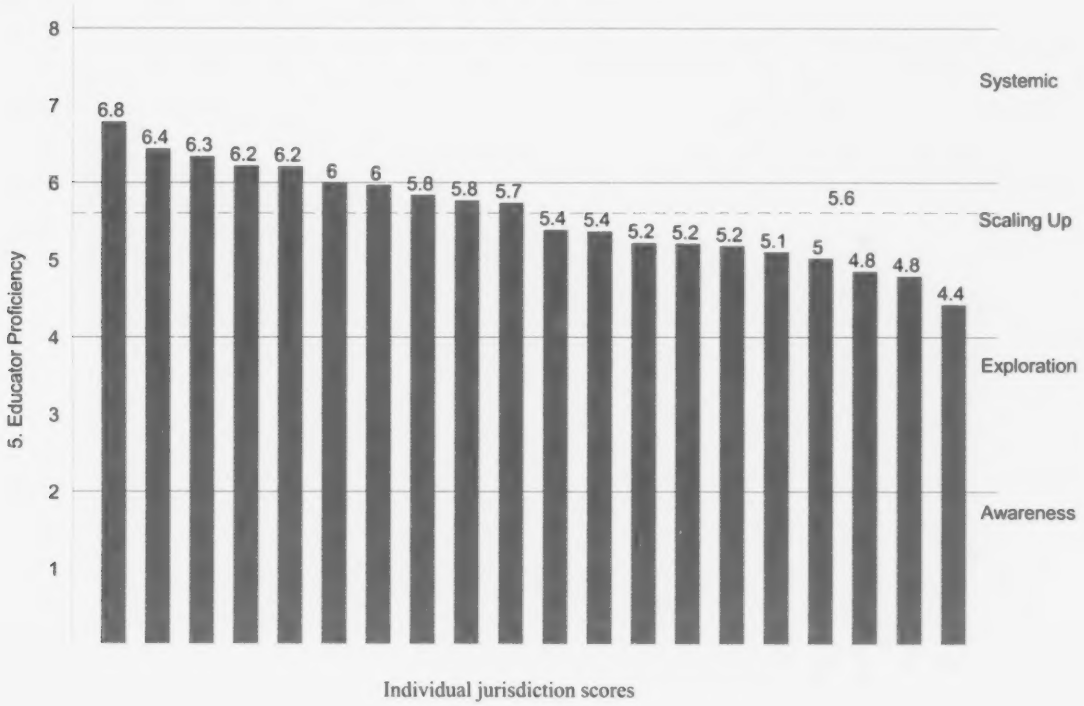


NOTE: 21CS = 21st Century Skills.

SOURCE: *Administrators surveys. Fall 2007, n=46, Spring 2009 n=46, Spring 2010 n=53.*

It seems that the professional development in the Emerge program paid off for a number of jurisdictions. Seven jurisdictions achieved the *Systemic* stage for the *Educator Proficiency* Dimension, with 10 in the *Scaling up* stage, and three in the *Exploration* stage.

Figure 43. Distribution of ***Educator Proficiency*** *scores by Jurisdiction: Spring 2010*



Source: *Spring 2010 surveys. N=116 teachers. N=53 administrators.*

Dimension 6: Access and Infrastructure

Discussion

From the Emerge program's inception, *Access and Infrastructure* has been a leading indicator. Due to the nature of the Emerge One-to-One Laptop Project, a large-scale infusion of technology was the first action of all of the Emerge jurisdictions. During the first year of the initiative most jurisdictions dedicated significant resources and personnel in providing one-to-one laptop computers and wireless network environments with sufficient access to support Emerge instructional programs. That said, there are still some programs where sufficiency has not been achieved, according to teachers.

Finding 4.8

Emerge teachers and administrators report having adequate access to computers and other peripherals, but do report some gaps in the access to more specialized technologies and to ongoing supplies (e.g., batteries, etc.).

Finding 4.9

While the majority of Emerge teachers report having access to fast reliable Internet connections, there remains a significant percentage (29%) of Emerge teachers who report less than adequate access, with reliability of the Internet more problematic than speed.

The Emerge teachers and administrators survey responses in Spring 2010 placed Emerge in the Scaling Up stage of readiness for Dimension 6 (5.6 on an 8-point scale, as compared to the baseline score of 5.5 in Fall 2007).

Spring 2010 Stage of Readiness: Access and Infrastructure

Awareness	*Exploration*	*Scaling Up*	*Systemic*
Access to technology and the infrastructure in place in the school is not sufficient to support rich, authentic 21st Century Learning. Technology problems and the lack of "just-in-time" availability reinforce the need for the status quo. Pioneers who attempt to implement innovative 21st Century Learning practices become frustrated with technological roadblocks.	Some elements of a comprehensive tech-ready environment are in place, often in support of grants or pilot initiatives. Planning processes are in place to support increased access and improved client support, but these processes will take time. Systems to provide seamless access to date are being envisioned, but do not currently exist.	Elements of a technically sophisticated, 21st Century teaching and learning environment have been planned for and are being rolled out. Data systems are in place and staff are beginning to use these systems in powerful ways. Tech support is increasingly available as needed, but may still be oriented more toward accomplishing the plan than meeting end-user needs.	Visitors to the school or district immediately recognize a 21st Century environment. Technology access is seamless and ubiquitous. All stakeholders have immediate access to the data that they need to support teaching and learning and problems are immediately solved through service-oriented support. New technologies are quickly evaluated and where found to be valuable, are incorporated in well-organized refresh cycles.

5.6 (compared to 5.5 in Fall 2007)

The Emerge classrooms in general have the adequate computers, laptop computers, LCD projectors, digital cameras, and digital white boards to meet current needs. However, they do report inadequate access to personal digital assistants, document cameras, scientific probes, and robotics kits as well as some supplies such as batteries. Data from the site visits confirmed that some additional digital equipment had been purchased (e.g., cameras, video recorders, and microphones) in response to the instructional needs in the classroom, and that generally stakeholders felt they have enough technology.

High percentages of Emerge administrators reported adequate, good, or excellent access to technologies and technical support services. Those percentages increased in Year 2, but declined slightly in Year 3, as seen in Table 15. Throughout the first year and into the second year, work continued by the jurisdictions to increase access, address technical issues or increase their ability to more quickly log onto the network. In this third year, jurisdictions found that the maturity of the technology brought with it maintenance issues such as batteries needing to be replaced, the need for additional chargers, and general repairs from simple wear and tear on some laptops.

A range of software and applications are being used to support student learning. Word processing and presentation software are used substantially, along with the use of the Internet for research and for access to web-based learning activities. Further, software for editing video, graphics and sound editing or production is being used as students are learning and creating in multimodal environments. The use of other communication tools such as instant messaging discussion boards, and videoconferencing continued to be used within various learning environments. In Spring 2010, examples of social networking, blogs, and wikis were being increasingly used in this last year of the Emerge project to support student learning.

Table 15: Trends in administrators' ratings of access, technical support, and infrastructure

	Year 1 (*N*=46)	Year 2 (*N*=46)	Year 3 (*N*=53)
Reliable, high-speed access to the internet in classrooms, labs, and media centers	37%	56%	68%
Technical support with little or no wait-time	74%	81%	56%
Reliability of computers, printers, projectors, and other equipment	65%	73%	62%

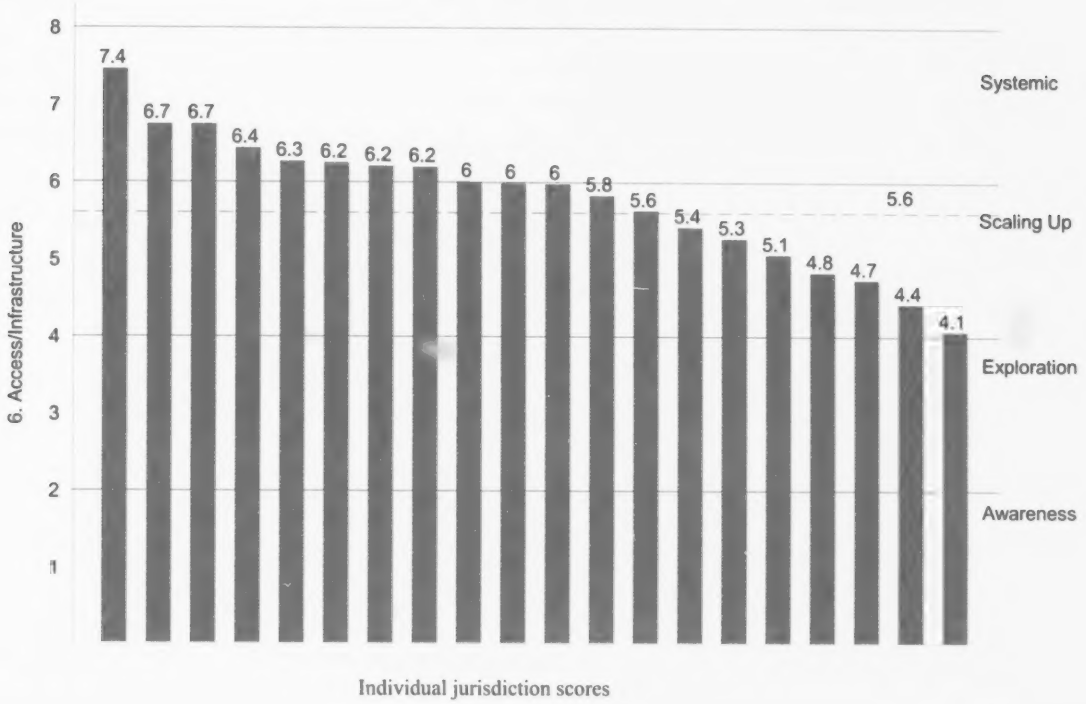
N=46 administrators (Years 1 and 2), Spring 2010 *N* = 53

Emerge administrators were asked to classify aspects of teachers' professional uses of technology as Non-existent, Very Poor, Adequate, Good, or Excellent. The percentage of administrators that rated the level of instructional support that helps teachers to integrate technology as Excellent or Good increased each year of the program, from 52% at baseline (2007) to 61% in Year 2, to 71% in Year 3.

Overall, teachers felt they did have good technical support, however as more computers and interactive whiteboards were installed in the jurisdictions, in Emerge classrooms and beyond, the technical support in some jurisdictions tended to be stretched further and further, which in some cases reduced support for the project.

As with the other dimensions, there is considerable variability across jurisdictions. Due to the grant funds, 11 of the jurisdictions moved into the Systemic stage, with nine in the Scaling up stage. While access and network capacity and reliability were fairly consistent across jurisdictions, the variability often came in the technical support areas. In some cases, a full-time technician was on-site at the school(s) to provide technical support. Others were simply included in the districts technical support structure, which varied in terms of responsiveness.

Figure 44. Distribution of ***Access/Infrastructure*** *scores by Jurisdiction: Spring 2010*



Source*: Spring 2010 surveys. N=116 teachers. N=53 administrators.*

Dimension 7: Accountability/Results

Discussion

The accountability dimension looks at the alignment between vision, goals, assessments, and results, plus the degree to which all educators in the system understand standards for results, and, finally, the results themselves.

> ***Finding 4.10***
>
> The percentage of teachers who reported their students clearly understood what would be required to demonstrate their attainment of 21st Century Skills increased from Year 1 to Year 3. Many teachers are using rubrics for the assessment for and of 21st Century Learning.

This was the lowest scoring dimension in Year 1, at 3.9 out of 8 points in the D21™ scale, placing it in the Exploration stage. This was due, in large part, to the new territory that 21st Century Skills represented for many of the Emerge jurisdictions. Through professional communities of practice sessions, webinars, and other professional development sessions, most jurisdictions are incrementally making progress in this dimension.

The Emerge teachers and administrators survey responses in Spring 2010 placed Emerge in the Scaling Up stage of readiness for Dimension 7 (4.5 on an 8-point scale, as compared to the baseline score of 3.9 in Fall 2007).

Spring 2010 Stage of Readiness: Accountability/Results

Awareness	*Exploration*	*Scaling Up*	*Systemic*
The district has a vision in place, but has not yet back mapped that vision into a logic model that clearly shows what needs to happen in order to achieve the vision. At this stage, leaders are investigating what matters in terms of readiness for 21st Century Learning and how to measure the critical readiness and outcomes measures for 21st Century Learning.	At this stage educators are beginning to identify what it takes to lead, learn, and teach for 21st Century Learning. They are also investigating new ways of measuring each of those elements (e.g., performance assessments to measure authentic work by students; team projects to measure collaboration, etc.). They are piloting new metrics and analyzing results.	The district is ready to document the elements of leading, learning, and teaching in the 21st Century. They have also identified and selected the metrics to measure both student outcomes and system indicators of progress toward these goals. They are in the process of communicating these definitions and metrics to all stakeholders and implementing a process that sets expectations, builds capacity for meeting those expectations, easily captures and makes available data on the metrics, and sets in motion a process for aligning all these elements into an accountability system that is set in motion.	All stakeholders are held accountable for high performances related to the district's vision for 21st Century Learning. The district has clearly articulated what is expected at all levels, in every facet of 21st Century teaching, learning, and leading. Leaders have prioritized funding to ensure strong support. The district has metrics, measures, and processes in place to ensure accountability. Data-driven decision making is embedded in the culture and is informing decision making and progress. As a result, the district is tracking outcomes for 21st Century leading, learning, and teaching, and is seeing progress toward the goals.

4.5 (compared to 3.9 in Fall 2007)

This dimension is at the lower stages of Scaling Up. Within the Emerge program, teachers and administrators have indicated –through surveys— that the vision has been established, there is an expectation that teachers integrate the vision into their daily lesson design, and many teachers are using rubrics to assess progress with 21st Century Skills and effective uses of technology.

Another measure of accountability is collected during the site visits, through student artifact reviews, and interviews with teachers. Generally, those measures indicated scores on the border of Exploration and Scaling Up.

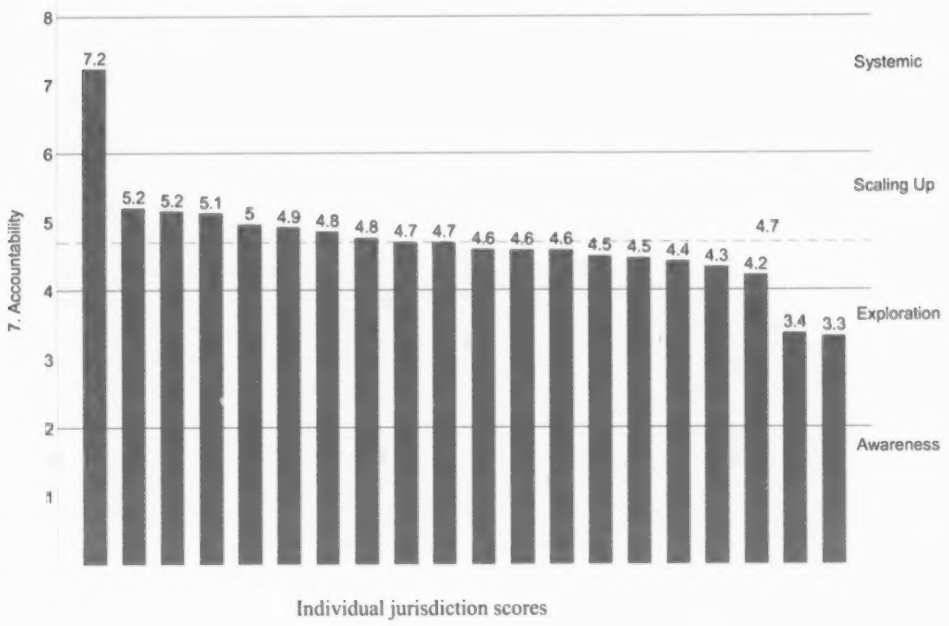
For example, each school jurisdiction submitted three student artifacts to be scored in terms of 21st Century Learning, authenticity, construction of knowledge and sophistication of technology use, all of which registered some increases over time, but remained at moderate levels. Similar levels were recorded during classroom observations. The artifacts submitted at the end of the second year reflect the product of a shift in the design of learning, along with how the technology is used to present and represent student understandings.

For both elementary and secondary there has been continuous increase in the scores for student artifacts over the three years. However, there was a minimal increase of scores between year two and three. The highest scores for year three for both elementary and secondary were for deep learning, 21st century context, and construction of knowledge. Over the three years, the area which had the least amount of growth was value outside of the classroom. The student work was not designed to be taken up by an authentic audience outside of the school environment.

In terms of Accountability, jurisdictions and schools are aligning the vision and expectations of classroom teachers to implement that vision in the Emerge classrooms. While many teachers have also aligned student assessment (in the form of rubrics) to that expectation, that movement has not generally been systemic. Many teachers are using rubrics to assess 21st Century Learning. Many are also using those rubrics with students to define 21st Century Skills and 21st Century Learning products to guide students' ongoing work. Some are also facilitating the development of student rubrics for use in assessment for learning.

The variability across the jurisdictions was substantial, with the top jurisdiction at 7.4 (out of 8.0) and the lowest rating at 3.3. Only one jurisdiction was in the Systemic stage, with 18 in the Scaling up stage, and two in the Exploration stage (see Figure 45). This dimension continues to lag behind the others, indicating that, while many are exploring the use of rubrics, the 21st Century Skills are not yet assessed systematically in most Emerge jurisdictions.

Figure 45. Distribution of ***Accountability*** *scores by Jurisdiction: Spring 2010*



Source: *Spring 2010 surveys. N=116 teachers. N=53 administrators.*

Summary

The 7 dimensions are interdependent elements of 21st Century readiness. Most of the jurisdictions made steady progress on all dimensions, and were discussing plans for extending the Emerge concepts beyond the current set of classrooms to the entire school.

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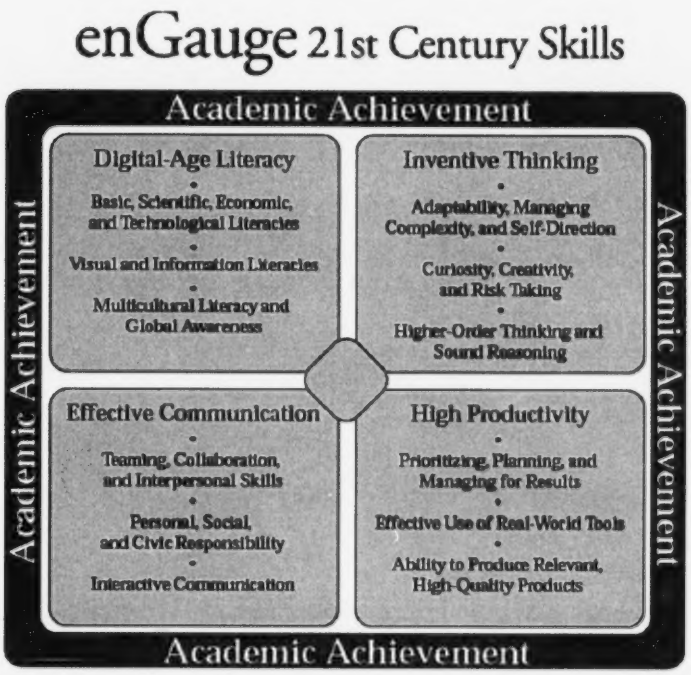
Appendix A: 21st Century Skills

Many of the Emerge proposals that were funded through Emerge used the enGauge framework for 21st Century Skills. That framework defines the 21st Century Skills as follows.



SOURCE: enGauge Framework for 21st Century Learning

A definition for each skill follows:

Digital-Age Literacy includes:

- ***Basic Literacy:*** Language proficiency (in English) and numeracy at levels necessary to function on the job and in society to achieve one's goals, and develop one's knowledge and potential in this Digital Age.
- ***Scientific Literacy:*** Knowledge and understanding of the scientific concepts and processes required for personal decision-making, participation in civic and cultural affairs, and economic productivity.
- ***Economic Literacy:*** The ability to identify economic problems, alternatives, costs, and benefits; analyze the incentives at work in economic situations; examine the consequences of changes in economic conditions and public policies; collect and organize economic evidence; and weigh costs against benefits.

- ***Technological Literacy:*** Knowledge about what technology is, how it works, what purposes it can serve, and how it can be used efficiently and effectively to achieve specific goals.

- ***Visual Literacy:*** The ability to interpret, use, appreciate, and create images and video using both conventional and 21st century media in ways that advance thinking, decision-making, communication, and learning.

- ***Information Literacy:*** The ability to evaluate information across a range of media; recognize when information is needed; locate, synthesize, and use information effectively; and accomplish these functions using technology, communication networks, and electronic resources.

- ***Multicultural Literacy:*** The ability to understand and appreciate the similarities and differences in the customs, values, and beliefs of one's own culture and the cultures of others.

- ***Global Awareness:*** The recognition and understanding of interrelationships among international organizations, nation-states, public and private economic entities, socio-cultural groups, and individuals across the globe

Inventive Thinking is comprised of the following "life skills":

- ***Adaptability/Managing Complexity:*** The ability to modify one's thinking, attitude, or behavior to be better suited to current or future environments, as well as the ability to handle multiple goals, tasks, and inputs, while understanding and adhering to constraints of time, resources, and systems (e.g., organizational, technological).

- ***Self-Direction:*** The ability to set goals related to learning, plan for the achievement of those goals, independently manage time and effort, and independently assess the quality of learning and any products that result from the learning experience.

- ***Curiosity:*** The desire to know or a spark of interest that leads to inquiry.

- ***Creativity:*** The act of bringing something into existence that is genuinely new and original, whether personally (original only to the individual) or culturally (where the work adds significantly to a domain of culture as recognized by experts).

- ***Risk-taking:*** The willingness to make mistakes, advocate unconventional or unpopular positions, or tackle extremely challenging problems without obvious solutions, such that one's personal growth, integrity, or accomplishments are enhanced.

- ***Higher-Order Thinking and Sound Reasoning:*** Include the cognitive processes of analysis, comparison, inference/interpretation, evaluation, and synthesis applied to a range of academic domains and problem-solving contexts.

Effective Communication involves:

Teaming and Collaboration: Cooperative interaction between two or more individuals working together to solve problems, create novel products, or learn and master content.

Interpersonal Skills: The ability to read and manage the emotions, motivations, and behaviors of oneself and others during social interactions or in a social-interactive context.

- ***Personal Responsibility:*** Depth and currency of knowledge about legal and ethical issues related to technology, combined with one's ability to apply this knowledge to achieve balance, integrity, and quality of life as a citizen, a family and community member, a learner, and a worker.
- ***Social and Civic Responsibility:*** The ability to manage technology and govern its use in a way that promotes public good and protects society, the environment, and democratic ideals.
- ***Interactive Communication:*** The generation of meaning through exchanges using a range of contemporary tools, transmissions, and processes.

High Productivity is currently not a high-stakes focus of schools, yet the skills involved in this cluster often determine whether a person succeeds or fails in the workforce:

- ***Prioritizing, Planning, and Managing for Results:*** The ability to organize to efficiently achieve the goals of a specific project or problem.
- ***Effective Use of Real-World Tools:*** Effective use of these tools – the hardware, software, networking, and peripheral devices used by Information Technology (IT) workers to accomplish 21st century work – means using these tools to communicate, collaborate, solve problems, and accomplish tasks.
- ***Ability to Produce Relevant, High-Quality Products:*** Intellectual, informational, or material products that serve authentic purposes and occur as a result of students using real-world tools to solve or communicate about real-world problems. These products include persuasive communications in any media (print, video, the Web, verbal presentation), synthesis of resources into more useable forms (databases, graphics, simulations), or refinement of questions that build upon what is known to advance one's own and others' understanding.

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